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(54) Light source bulb with two filaments

Lichtquelle mit Kolben und zwei Fäden

Source lumineuse à ampoule avec deux filaments

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Description

BACKGROUND OF THE INVENTION

a) Field of the Invention

[0001] The present invention relates to a light source bulb in automotive headlamps, such as two-lamp type halogen headlamps, in which a prescribed low beam distribution pattern and high beam distribution pattern each can be obtained by entire-surface reflection light distribution control of the reflecting surface of a reflector, the light source bulb being capable of use both as a light source bulb in an automotive headlamp for right traffic and a light source bulb in an automotive headlamp for left traffic in one, without causing a problem of virtual image glare.

[0002] Incidentally, as employed in the present specification document and the accompanying drawings, the symbol "A" represents the front as seen from the driver-side along the traveling direction of an automobile. As seen in the same manner, the symbol "B" represents the back, the symbol "L" the left, the symbol "R" the right, the symbol "U" the upper, and the symbol "D" the lower. In addition, the symbols "HL-HR" represent a horizontal line seen in front from the driver-side (i.e., driver's view), and the symbols "HR-HL" represent a horizontal line seen as the automobile- or the headlamp-side is viewed from the front (so-called front view or plane view). The symbols "VU-VD" represent a vertical line. Further, as employed both in the appended claims and in the present specification document, the terms "front," "back," "left," "right," "upper," and "lower" each has the same meaning.

b) Description of the Prior Art

[0003] Automotive headlamps in which a prescribed low beam distribution pattern and high beam distribution pattern each can be obtained by entire-surface reflection light distribution control of the reflecting surface of its reflector include, for example, those described in Japanese Patent Laid-Open Publication No. Hei 8-329703.

[0004] Hereinafter, the outline of such an automotive headlamp will be described with reference to Figs. 1 through 3. Note that the automotive headlamp illustrated is to be mounted on the left side of an automobile for right traffic. An automotive headlamp to be mounted on an automobile for left traffic is the reverse of this illustrated automotive headlamp in the horizontal arrangement of a reflecting surface 40, a high-beam filament 52, and the like. Moreover, an automotive headlamp to be mounted on the right side of an automobile, while identical to this illustrated automotive headlamp in the arrangement of the reflecting surface 40, the high-beam filament 52, and the like, replaces its lamp housing 1, lens 2, and reflector 4 with those generally symmetrical in shape.

[0005] This automotive headlamp has a lamp chamber 3 defined by the lamp housing 1 and the lens (outer lens) 2. In this lamp chamber 3, the reflector 4 separately formed from the lamp housing 1 is arranged to be rotatable in vertical and horizontal directions, by a pivot mechanism (not shown), an optical axis adjustment mechanism (not shown), and the like. This reflector 4 has a reflecting surface 40 constituted by a complex reflecting surface. This reflecting surface 40, i.e. the complex reflecting surface, comprises reflecting surface segments (not shown) sectioned in a plurality of pieces all around, and is referred to as so-called free-form curved surface. This complex reflecting surface, as described in Japanese Patent Laid-Open Publication No. Hei 9-306220 for example, includes that divided into a large number of blocks, that divided into a small number of blocks, and that having a plurality of blocks continuously connected with one another (the connecting lines therebetween not being visible).

[0006] In the strict sense, this complex reflecting surface has more than one single focus. The plurality of paraboloids of revolution constituting the complex reflecting surface, however, differ in focal length from each other but merely slightly, and practically share the same focus. Thus, the focus will be referred to as focus F in the present specification document, while the focus F shown in the drawings is a pseudo focus in the strict sense. Similarly, while the optical axis Z-Z (also referred to as reference axis Z-Z) shown in the drawings is a pseudo optical axis in the strict sense, it will be referred to as optical axis in the present specification document.

[0007] To the above-described reflector 4 is detachably attached a light source bulb 5. This light source bulb 5 is a light source bulb with no shading hood, in which a low-beam (dipped-beam) filament 51 and a high-beam (main-beam) filament 52 are arranged in a glass envelope 50, and this glass envelope is provided with, e.g., coating 54 of black paint (for intercepting direct lights from the low-beam filament 51 and high-beam filament 52 to the lens 2) at an extremity thereof.

[0008] The low-beam filament 51 mentioned above forms a generally cylindrical shape of coil structure, and is generally parallel to the optical axis Z-Z. This filament 51 is positioned forward of the focus F. The high-beam filament 52 also forms a generally cylindrical shape of coil structure, and is generally parallel to the optical axis Z-Z. This filament 52 is positioned in the vicinity of the focus F and obliquely below the low-beam filament 51 (at the lower rightward as shown in Fig. 11A, for the right-traffic; at the lower leftward as shown in Fig. 6C, for the left-traffic). The central axis of the low-beam filament 51 described above generally coincides with the aforementioned optical axis Z-Z (reference axis Z-Z), and lies below the central axis of the aforementioned glass envelope 50, i.e., below the envelope axis Z'-Z'. The reason why the central axis Z-Z of this low-beam filament 51 is positioned below the envelope axis Z'-Z' is to obtain a stable light-shade boundary line 71 (so-called cut line)

in the low-beam distribution pattern shown in Fig. 4 to be described later. That is, as previously known, the central axis Z-Z of the low-beam filament 51 is shifted to downward of the envelope axis Z'-Z' to prevent the converged image (virtual image) of the reflected light in the inner peripheral portion of the glass envelope 50 from appearing above the light-shade boundary line 71 of the low beam distribution pattern LP.

[0009] In the drawings, reference numeral 6 designates a shade. This shade 6 is fixed to the aforesaid reflector 4 and covers the front of the aforesaid light source bulb 5, so as to intercept the direct lights from the low-beam filament 51 and the high-beam filament 52 to the invalid portions 42 (portions with no direct involvement to the light distribution of the headlamp) of the reflector 4 and to the lens 2. In addition, reference numeral 60 designates a rubber cap. This rubber cap 60 is watertightly and detachably attached to between the base of the light source bulb 5 and the rear opening portion of the lamp housing 1 via an attaching cap 61, thereby maintaining the interior of the lamp chamber 3 watertight.

[0010] Now, when in the automotive headlamp described above the low-beam filament 51 is lit, lights from this low-beam filament 51 are reflected over the entire surface of the reflecting surface 40 of the reflector 4, and the reflected lights are irradiated out through the lens 2 with the prescribed low beam distribution pattern LP shown in Fig. 4. When in contrast the high-beam filament 52 is lit, lights from this high-beam filament 52 are reflected over the entire surface of the reflecting surface 40, and the reflected lights are irradiated out through the lens 2 with a prescribed high beam distribution pattern HP shown in Fig. 5.

[0011] In this way, the prescribed low beam distribution pattern LP and the prescribed high beam distribution pattern HP each is formed by the entire-surface reflection light distribution control of the reflecting surface 40 of the reflector 4.

[0012] The prescribed low beam distribution pattern LP and prescribed high beam distribution pattern HP mentioned above designate those light distribution patterns conformable to light distribution standards such as ECE Reg. the European light distribution standards, the ones based on the same (e.g., Japanese type approval standard and the like), and FMVSS the North America light distribution standards.

[0013] The low beam distribution pattern LP described above is standardized in light distribution so as to limit the occurrence of glare. This results in the aforementioned low beam distribution pattern LP with the light-shade boundary line 71, as shown in Fig. 4, taking account of a car 7 on the opposite lane and a pedestrian 70 on the right shoulder of the road. More specifically, this light-shade boundary line 71 comprises a horizontal line portion 72, a gentle tilt line portion 73, and a tilt line portion 74. The horizontal line portion 72 extends from the left end to the approximate center, lying somewhat below the horizontal line HL-HR so as not to cause glare to the car 7 on the opposite lane. The gentle tilt line portion 73 tilts up rightward from the horizontal line portion 72 at the approximate center with a gentle angle, e.g. an angle of 15°, so as to observe the pedestrian 70 on the right shoulder without causing glare to the pedestrian 70. The tilt line portion 74 tilts down rightward from the gentle tile line portion 73 to return to the horizontal line portion 72 again. This low beam distribution pattern LP has no standard on the maximum value of light intensity. In contrast, the high beam distribution pattern HP mentioned above is standardized in light distribution on the maximum value of light intensity and the maximum light intensity zone. This results in the above-mentioned high beam distribution pattern HP having a hot zone HZ (the maximum light intensity zone including the maximum light intensity point) at the center, as shown in Fig. 5. Here, in the European light distribution standards ECE Reg., the maximum value of light intensity is 48-240 lx (1 lx = 625 cd; measurement on a 25-m-away screen), and the value of light intensity at the intersection between the horizontal line HL-HR and the vertical line VU-VD is equal to or greater than 80% (certified) the maximum value of light intensity.

[0014] What is important in the automotive headlamp described above is that a favorable low beam distribution pattern LP can be obtained without causing the glare problem, as well as that a favorable high beam distribution pattern can be obtained.

[0015] Here, the light source bulb 5 described above is divided into a left-traffic light source bulb 5L for use in an automotive headlamp for left traffic or a right-traffic light source bulb 5R for use in an automotive headlamp for right traffic, both for dedicated use. More specifically, the left-traffic light source bulb 5L has a high-beam filament 52 positioned at the lower leftward of its low-beam filament 51, as shown in Figs. 6C and 15A. Meanwhile, the right-traffic light source bulb 5R has a high-beam filament 52 positioned at the lower rightward of its low-beam filament 51, as shown in Figs. 11A and 12A. Thus, the high-beam filaments 52 in the left-traffic light source bulb 5L and the right-traffic light source bulb 5R are arranged in symmetric positions to each other with respect to the central axis Z-Z of the low-beam filament 51.

[0016] On this account, the light source bulb 5 described above is rotated to the right or left about the central axis Z-Z of the low-beam filament 51 so that the light source bulb 5 can cope with both the left-traffic light source bulb 5L and the right-traffic light source bulb 5R in one.

[0017] However, depending on conditions in constituting the light source bulb 5, the above-described rotation can produce a change in light distribution which might be an obstacle to the function of the low-beam filament 51, i.e., a glare problem.

[0018] Hereinafter, the aforementioned glare problem will be described in conjunction with the case of resulting from lead wires and support wires of the light source

bulb 5 and the case of resulting from the glass envelope of the light source bulb 5, with reference to Figs. 6A-11C and Figs. 12A-15D, respectively.

[0019] First, description will be given of the glare problem resulting from lead wires and support wires of the light source bulb 5.

[0020] In a left-traffic light source bulb 5L, lead wires LW1, LW2, LW3, and LW4, and support wires SW1, SW2, and SW3 are arranged as shown in the neutral state of Figs. 6B, 7, and 8. More specifically, a first lead wire LW1 extended from the front end 51A (the corner between the front end 51A and upper end 51U) of the low-beam filament 51 is supported on the front end portion of a first support wire SW1. A second lead wire LW2 extended from the rear end 51B (the corner between the rear end 51B and upper end 51U) of the low-beam filament 51 is supported on the upper part of the vertical bent part of a second support wire SW2. A third lead wire LW3 extended from the rear end 52B (the corner between the rear end 52B and upper end 52U) of the high-beam filament 52 is supported on the lower part of the vertical bent part of the aforesaid second support wire SW2. A fourth lead wire LW4 extended from the front end 52A (the corner between the front end 52A and lower end 52D) of the high-beam filament 52 is supported on the front end portion of a third support wire SW3. Each of the aforesaid support wires SW1, SW2, and SW3 is supported on a bridge 57 made of glass. The aforesaid first lead wire LW1, second lead wire LW2, third lead wire LW3, first support wire SW1, and second support wire SW2 are positioned on the vertical line VU-VD connecting the low-beam filament 51 to the high-beam filament 52. The aforesaid fourth lead wire LW4 and third support wire SW3 lie at approximately the same level as that of the high-beam filament 52. This third support wire SW3 is extended from the bridge 57 to the front partway, where the wire is once bent leftward to avoid the high-beam filament 52 before it is bent again and extended to the front.

[0021] This left-traffic light source bulb 5L in its neutral state shown in Figs. 6B, 7, and 8 is then rotated to the right or left about the central axis Z-Z of the low-beam filament 51, and built into an automotive headlamp for left traffic in the state shown in Fig. 6C for use. Lighting the low-beam filament 51 of this left-traffic light source bulb 5L offers a prescribed low beam distribution pattern (light distribution pattern horizontally inverted from the low beam distribution pattern LP shown in Fig. 4). Lighting the high-beam filament 52 offers a prescribed high beam distribution pattern (light distribution pattern horizontally inverted from the high beam distribution pattern HP shown in Fig. 5). When the low-beam filament 51 is lit as mentioned above, the radiation of the low-beam filament 51 illuminates each wire LW1, LW2, LW3, LW4, and each support wire SW1, SW2, SW3 to shine (the closer to the low-beam filament 51 and the larger the exposed area is, the higher the intensity is).

[0022] Here, in the cases where the left-traffic light source bulb 5L in its neutral state is rotated to the right or left about the central axis Z-Z of the low-beam filament 51 and built into a right-traffic automotive headlamp in the state shown in Fig. 6A for use, a glare problem arises as described below.

[0023] That is, when the left-traffic light source bulb 5L is incorporated with a right-traffic automotive headlamp for use, the fourth lead wire LW4 and the third support wire SW3 are positioned below the lower end 51D of the low-beam filament 51, as shown in Fig. 6A. On this account, as shown in Fig.9, the lower end 51D of the low-beam filament 51 appears above the light-shade boundary line 71 (the horizontal line portion 72, the gentle tilt line portion 73), and the low-beam filament 51, the first lead wire LW1, second lead wire LW2, and first support wire SW1 (also including the high-beam filament 52, third lead wire LW2, and second support wire SW2, even though omitted of illustration in Fig. 9) appear below the light-shade boundary line 71. Meanwhile, the aforesaid fourth lead wire LW4 and third support wire SW3 positioned below the lower end 51D of the low-beam filament 51 appear above the light-shade boundary line 71 (the horizontal line portion 72, the gentle tilt line portion 73). Incidentally, in Fig. 9, the images of the low-beam filament 51, the high-beam filament 52, each lead wire LW1, LW2, LW3, LW4, and each support wire SW1, SW2, SW3 are diffused to the right and left, or to the upper right and lower left, as shown by the arrows.

[0024] As a result, the fourth lead wire LW4 and third support wire SW3 described above make virtual image glare. This causes, as shown in Fig. 10, the virtual image glare VIG to appear on the point P (B50L; a point shown by the double circle in Fig. 10) and zone Z (zone III; a part shown by the oblique lines in Fig. 10, exceeding the limit) where glare is severely restricted by the European light distribution standards ECE Reg.

[0025] The foregoing constitutes the description on the production of the glare problem in the case where a left-traffic light source bulb 5L is built into a right-traffic automotive headlamp for use. Hereinafter, referring to Fig. 11, description will be made on the glare problem in the case where a right-traffic light source bulb 5R is incorporated with a left-traffic automotive headlamp for use.

[0026] As shown in its neutral state of Fig. 11B, this right-traffic light source bulb 5R has a fourth lead wire LW4 and a third support wire SW3 positioned on the right of its high-beam filament 52, at approximately the same level as that of the high-beam filament 52. On this account, no glare problem arises when the bulb in its neutral state shown in Fig. 11B is rotated to the right or left about the central axis Z-Z of the low-beam filament 51 and incorporated with a right-traffic automotive headlamp for use in the state shown in Fig. 11A. In contrast, when the bulb in its neutral state shown in Fig. 11B is rotated to the right or left about the central axis Z-Z of the low-beam filament 51 and built into a left-traffic automotive headlamp for use in the state shown in Fig.

11C, the third support wire SW3 and the fourth lead wire LW4 are situated below the lower end 51D of the low-beam filament 51, which gives rise to a problem of the virtual image glare as in the above-described case where the left-traffic light source bulb 5L is used in a right-traffic headlamp.

[0027] Thus, in conventional light source bulbs 5 as described above, a single (identical) light source bulb 5 cannot be used both as a left-traffic light source bulb 5L and a right-traffic light source bulb 5R. In other words, a left-traffic automotive headlamp uses the left-traffic light source bulb 5L shown in Figs. 6B, 7, and 8, in the state of Fig. 6C, and a right-traffic automotive headlamp uses the right-traffic light source bulb 5R shown in Fig. 11B, in the state of Fig. 11A.

[0028] Moreover, when in the conventional light source bulbs 5L and 5R described above the lower end SW2' of the vertical bent part on the front end portion of the second support wire SW2 is provided below a product L8 drawn from the lower end 51D of the low-beam filament 51 as shown in Figs. 6A-6C, 8, and 11A-C, the lower end SW2' of the second support wire SW2 can sometimes be situated below the lower end 51D to produce the problem of the virtual image glare.

[0029] Document WO 98/49716 discloses a lamp capsule for use in a vehicle headlamp which includes a lamp envelope having a tubular portion. First and second spaced-apart filaments are mounted in the lamp envelope for emitting light when energized by electrical energy. The lamp capsule further includes one or more light-attenuating axial stripes on the lamp envelope. The axial stripes are positioned on the lamp envelope for blocking light emitted by the first filament and reflected by the second filament. The lamp capsule may further include light-attenuating rings at or near opposite ends of the lamp envelope for defining upper and lower boundaries of a clear region of the lamp envelope. Portions of support leads as in the lamp envelope are substantially coplanar with the filaments. The plane containing the filaments and the support leads is preferably parallel to the long dimension of a press seal. This configuration permits the lamp capsule to be rotated about one of the filaments for left hand drive and right hand drive applications.

[0030] Next, description will be made on the glare problem resulting from the glass envelope of the light source bulb 5.

[0031] The glass envelope 50 of a light source bulb 5R to be used for a right-traffic automotive headlamp has a hollow cylindrical shape, as shown in Figs. 12A-12D. The rear end part 53 of this glass envelope 50 is sealed at portions on both the right and left sides with respect to the vertical line VU-VD. As shown in Fig. 12A, this results in the central portion 53C of the rear-end sealed part 53 being squeezed into a generally rectangular, planiform shape elongated along the vertical line VU-VD as seen from the front. Besides, as shown in Fig. 12C, the portions 53L and 53R on the both right and left sides of this rear-end sealed part 53 are deformed to curve as seen in plan (from the top).

[0032] On this account, when the right-traffic light source bulb 5R shown in Figs. 12A, C, and D is rotated to the right'or left about the central axis Z-Z of the low-beam filament 51 for use as the . left-traffic light source bulb shown in Fig. 12B, the curve-deformed portions 53L and 53R on the left and right are situated up and down. Under the up and down situations of the left and right curve-deformed portions 53L and 53R, the light from the low-beam filament 51 through the middle envelope part (having a flat-shaped cross-section), as shown in Fig. 13, keeps proceeding straight as shown by the arrowed broken line, causing no problem to the low beam distribution pattern LP; in the meantime, the light passing through the left curve-deformed portion 53L situated up changes its optical path as shown by the arrowed full line, which may produce glare on the low beam distribution pattern LP and create a light distribution problem, possibly causing a trouble in terms of the light distribution standards mentioned above.

[0033] In order to solve the problem mentioned above, it is therefore contemplated to cover the curve-deformed portions 53L and 53R with a ring-shaped cap 58. The fitting of this cap 58, however, causes another problem described below. That is, lights L10, L20, L30, and L40 from the low-beam filament 51 and high-beam filament 52 are intercepted by the cap 58 with great losses D1 and D2 in the quantity of distributed lights. Incidentally, in Fig. 14, L10 designates the light extending from the corner 51BU formed between the rear end and upper end of the low-beam filament 51 through the corner of the cap 58; L20 the light extending from the corner 51BD formed between the rear end and lower end of the low-beam filament 51 through the corner of the cap 58; L30 the light extending from the corner 52BU formed between the rear end and upper end of the high-beam filament 52 through the corner of the cap 58; L40 the light extending from the corner 52BD formed between the rear end and lower end of the high-beam filament 52 through the corner of the cap 58; D1 the loss area (invalid portion) of the quantity of distributed low beam; and D2 the loss area (invalid portion) of the quantity of distributed high beam. The fitting of the cap 58 also increases the number of component parts, the number of assembling processes and the like, which is undesirable in terms of costs.

[0034] The foregoing constitutes the description on the production of the glare problem in the case where a right-traffic light source bulb 5R is built into a left-traffic automotive headlamp for use. Similarly, when the left-traffic light source bulb 5L shown in Figs. 15A, C, and D is rotated to the right or left about the central axis Z-Z of the low-beam filament 51 for use as a right-traffic light source bulb shown in Fig. 15B, the right and left curve-deformed portions 53R and 53L are also situated up and down to cause the glare problem as described above.

SUMMARY OF THE INVENTION

[0035] It is an object of the present invention to provide a light source bulb in an automotive headlamp, which can be used both as a left-traffic light source bulb and a right-traffic light source bulb, where optical path changes in the rear-end sealed part, the production of glare light and problems with light distribution are eliminated without a loss of quantity of low beam and/or high beam.

[0036] In order to achieve the foregoing object, the light source bulb according to claim 1, 3 and 4 is characterized in that the boundary between the middle envelope part and the rear-end sealed part of the glass envelope is positioned behind a line connecting the corner formed between the rear end and upper end of the high-beam filament to a corner formed between the reflecting surface of the reflector and the inner periphery of the insertion through-hole.

[0037] This results in that: due to the configuration described above, the light source bulb of claims 1, 3 and 4, in either use as a right-traffic light source bulb or a left-traffic light source bulb, has the lights from the low-beam filament and high-beam filament reaching the reflecting surface of the reflector without passing through the rear-end sealed part of the glass envelop, even when the right and left curve-deformed portions are situated up and down. This eliminates the optical-path changes in the rear-end sealed part, the production of glare light, and the problem with light distribution. In addition, the lights from the low-beam filament and the high-beam filament reach the entire reflecting surface of the reflector, thereby eliminating the loss in quantity of the low beam and the high beam.

[0038] Furthermore, in order to achieve the foregoing object, the light source bulb according to claims 2-4 is characterized in that the boundary between the middle envelope part and the rear-end sealed part of the glass envelope is positioned behind a line connecting the corner formed between the rear end and upper end of the low-beam filament in its initial state to a corner formed between the reflecting surface of the reflector and the inner periphery of the insertion through hole.

[0039] This results in that: due to the configuration described above, the light source bulb, according to claims 2-4 in either use as a right-traffic light source bulb or a left-traffic light source bulb, has the lights from the low-beam filament reaching the reflecting surface of the reflector without passing through the rear-end sealed part of the glass envelop, even when the right and left curve-deformed portions are situated up and down. This eliminates the optical-path changes in the rear-end sealed part, the production of glare light, and the problem with light distribution. In addition, the lights from the low-beam filament reach the entire reflecting surface of the reflector, thereby eliminating the loss in quantity of the low beam.

[0040] Thus, the light source bulbs of the present invention can be used both as a left-traffic light source bulb and a right-traffic light source bulb in one.

[0041] The nature, principle and utility of the invention will become more apparent from the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042] In the accompanying drawings:

Fig. 1 is a front view showing an automotive headlamp using a conventional light source bulb, the reflecting surface and the shade of its reflector being seen through a lens;
Fig. 2 is a sectional view on the line II-II in Fig. 1;
Fig. 3 is a sectional view on the line III-III in Fig. 1;
Fig. 4 is an image diagram of a low beam distribution pattern;
Fig. 5 is an image diagram of a high beam distribution pattern;
Fig. 6A is a front view of a conventional left-traffic light source bulb being used as a right-traffic light source bulb, Fig. 6B is a front view of the conventional left-traffic light source bulb in its neutral state, and Fig. 6C is a front view of the conventional left-traffic light source bulb in use;
Fig. 7 is a view (plan view) taken along the arrow VII in Fig. 6B;
Fig. 8 is a view (side view) taken along the arrow VIII in Fig. 6B;
Fig. 9 is a screen image diagram for explaining the virtual image glare caused by a conventional light source bulb;
Fig. 10 is an iso-luminance chart in the case where a conventional left-traffic light source bulb is used as a right-traffic light source bulb, the diagram showing virtual image glare distributed over the point and zone where glare is severely restricted by the European light distribution standards ECE Reg.;
Fig. 11A is a front view of a conventional right-traffic light source bulb in use, Fig. 11B is a front view of the conventional right-traffic light source bulb in its neutral state, and Fig. 11C is a front view of the conventional right-traffic light source bulb being used as a left-traffic light source bulb;
Fig. 12A is a front view of a conventional right-traffic light source bulb, Fig. 12B is a front view of the conventional right-traffic light source bulb being situated as a left-traffic light source bulb, Fig. 12C is a view taken along the arrow C in Fig. 12A, and Fig. 12D is a view taken along the arrow D in Fig. 12A;
Fig. 13 is a partial longitudinal sectional view showing the problem in the case where a conventional right-traffic light source bulb is used as a left-traffic light source bulb;
Fig. 14 is a partial longitudinal sectional view showing the problem in the case a cap is fit to the same;

Fig. 15A is a front view of a conventional left-traffic light source bulb, Fig. 15B is a front view of the conventional left-traffic light source bulb being situated as a right-traffic light source bulb, Fig. 15C is a view taken along the arrow C in Fig. 15A, and Fig 15D is a view taken along the arrow D in Fig. 15A;
Fig. 16 is a partial longitudinal sectional view showing an embodiment of the light source bulb of the present invention;
Fig. 17 is a partial longitudinal sectional view showing another embodiment of the light source bulb of the present invention; and
Fig. 18A is a partial plan view showing a variation example of the present invention, and Fig. 18B is a partial side view showing the same.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0043] Hereinafter, embodiments of the light source bulbs of the present invention will be described with reference to Figs. 16 through 18B. In the drawings, like numerals or symbols of those in Figs 1 through 15D designate like parts.

[0044] Fig. 16 shows an embodiment of the light source bulb of the present invention.

[0045] In this light source bulb 500A, the boundary 59 (the starting points of the curve-deformed portions 53L and 53R of the rear-end sealed part 53) between the middle envelope part and the rear-end sealed part 53 (the part shown the oblique lines in the figure) of the glass envelope 50 is positioned behind a line L50 connecting the corner 52BU formed between the rear end and upper end of the high-beam filament 52 in the neutral state to a corner formed between the reflecting surface 40 of the reflector 4 and the inner periphery of the insertion through-hole 41.

[0046] The light source bulb 500A of the present invention in this embodiment has such configuration as described above. Accordingly, when this light source bulb 500A is rotated to the left and right about the central axis Z-Z of the low-beam filament 51 for use as a right-traffic light source bulb and a left-traffic light source bulb, respectively, the light L70 (shown by a broken line, in the figure) from the low-beam filament 51 and the light L50 (shown by a full line, in the figure) from the high-beam filament 52 reach the reflecting surface 40 of the reflector 4 without passing through the rear-end sealed part 53 of the glass envelope 50 even if the right and left curve-deformed portions 53R, 53L are situated up and down. This eliminates the optical-path changes in the curve-deformed portions 53L and 53R of the rear-end sealed part 53, the production of glare, and the light-distributional problem. Besides, the lights from the low-beam filament 51 and the high-beam filament 52 reach the entire reflecting surface 40 of the reflector 4, thereby eliminating the losses in quantity of the low beam and the high beam.

[0047] Here, it should be noted that the light source bulb 500A shown in Fig. 16 is in its most disadvantageous, neutral state. When this light source bulb 500A in the neutral state is rotated to the right or left about the central axis Z-Z of the low-beam filament 51 for use as a left-traffic light source bulb or a right-traffic light source bulb, respectively, the high-beam filament 52 shown in Fig. 16 approaches the optical axis Z-Z and thereby eliminates the light-distributional problem resulting from glare, and the losses in the quantity of distributed lights.

[0048] Thus, the light source bulb 500A of the present invention in this embodiment can be used both as a left-traffic light source bulb and a right-traffic light source bulb in one, without the light-distributional problem due to glare of low beam and the losses in the quantity of distributed low beam and high beam.

[0049] Next, description will be given of the concrete dimensions of major components.

[0050] The pseudo focus F value of the reflector 4 is equivalent to a 20-to-30-mm focus value of the paraboloids of revolution, in consideration of the size for an automotive headlamp and the magnitude (solid angle) of the emission pattern required for the light distribution.

[0051] The distance between the center of the low-beam filament 51 and the center of the high-beam filament 52 in the front view is 2.0-3.5 mm.

[0052] The lengths c of the low-beam filament 51 and the high-beam filament 52 are 4.0-6.0 mm in consideration of life, luminous flux, efficiency, dimension of the light source image required for the light distribution, and the like.

[0053] The inner diameter of the insertion through-hole 41 is equal to or greater thanϕ30 mm on account of the assembly size of the above-described light source bulb 500.

[0054] Among the concrete dimensions of the major components mentioned above, those constituting the most disadvantageous condition are combined to obtain α (an angle formed between the line L50 described above and a line L60 which is perpendicular to the optical axis Z-Z and drawn through the rear end of the high-beam filament 52, the angle showing the required range of the middle envelope part to the starting point of the rear-end sealed part 53 of the glass envelope 50),resulting in that α = 55° (where a: 30 mm, b: 3.5 mm, c: 6.0 mm, andd: ϕ30 mm). Here, any combination of the conditions conceivable for a realistic solution produces no light-distributional problem resulting from glare of low beam, nor loss in the quantity of distributed low beam and light beam.

[0055] Fig. 17 is a partial longitudinal sectional view showing another embodiment of the light source bulb of the present invention.

[0056] In this light source bulb 500B, the boundary 59 between the middle envelope part and the rear-end sealed part 53 (the part shown by the oblique lines in the figure) of the glass envelope 50 is positioned behind a line L70 connecting the corner 51BU formed between

the rear end and upper end of the high-beam filament 51 in the neutral state to a corner formed between the reflecting surface 40 of the reflector 4 and the inner periphery of the insertion through-hole 41.

[0057] The light source bulb 500B in this embodiment has such configuration as described above; therefore, when this light source bulb 500B is rotated to the left and right about the central axis Z-Z of the low-beam filament 51 for use as a right-traffic light source bulb and a left-traffic light source bulb, respectively, the light (shown by a full line, in the figure) L70 from the low-beam filament 51 reaches the reflecting surface 40 of the reflector 4 without passing through the rear-end sealed part 53 of the glass envelope 50 even if the right and left curve-deformed portions 53R, 53L are situated up and down. This eliminates the optical-path changes in the curve-deformed portions 53L and 53R of the rear-end sealed part 53, the production of glare, and the light-distributional problem. Besides, the lights from the low-beam filament 51 reach the entire reflecting surface 40 of the reflector 4, thereby eliminating the loss in the quantity of low beam.

[0058] It should be noted here that the light source bulb 500B shown in Fig. 17 is in its most disadvantageous, neutral state. When this light source bulb 500B in the neutral state is rotated to the right and left about the central axis Z-Z of the low-beam filament 51 for use as a left-traffic light source bulb or a right-traffic light source bulb, respectively, the high-beam filament 51 shown in Fig. 29 remains there, eliminating the light-distributional problem resulting from glare as well as the loss in the quantity of distributed lights.

[0059] Thus, the light source bulb 500B in this embodiment can be used both as a left-traffic light source bulb and a right-traffic light source bulb in one, without the light-distributional problem due to low beam glare or the loss in the quantity of distributed low beam.

[0060] Among the concrete dimensions of the major components mentioned above, those constituting the most disadvantageous condition are combined to obtain β (an angle formed between the line L70 described above and a line L80 which is perpendicular to the central axis Z-Z and drawn through the rear end 51B of the low-beam filament 51, the angle showing the required range of the middle envelope part to the starting point of the rear-end sealed part 53 of the glass envelope 50), resulting in that $\beta = 62°$ (where a: 30 mm, c: 6.0 mm, and d: ϕ30 mm). Here, any combination of the conditions conceivable for a realistic solution produces no light-distributional problem resulting from low beam glare, nor loss in the quantity of distributed low beam.

[0061] Figs. 18A and 18B are a partial plan view and a partial side view of a variation example on the light source bulb 500A of the embodiment of the present invention described with reference to Fig. 16 and the light source bulb 500B of the embodiment of the present invention described with reference to Fig. 17.

[0062] In the light source bulbs 500A and 500B of this variation example, the corner between the front end and upper end of the low-beam filament 51 is supported by a first lead wire LW1 and a first support wire SW1. The corner between the rear end and upper end of the low-beam filament 51 and the corner between the rear end and upper end of the high-beam filament 52 are supported by a second lead wire LW2, a third lead wire LW3, and a second support wire SW2. The corner between the front end and lower end of the high-beam filament 52 is supported by the fourth lead wire LW4 and a third support wire SW3. Moreover, the support wires SW1, SW2, and SW3 mentioned above are fixed to and supported by a bridge 57 made of glass, and this bridge 57 is contained in a rear-end sealed part 53 (the part shown by the oblique lines in the figures).

[0063] In the light source bulbs 500A and 500B of this variation example, the lead wires LW1, LW2, LW3, and LW4, and support wires SW1, SW2, and SW3 each is positioned, as in the front view of the light source bulbs 500A and 5008 in the neutral state, between a product drawn from the left end of the low-beam filament 51 through the left end of the high-beam filament 52 and a product drawn from the right end of the low-beam filament 51 through the right end of the high-beam filament 52. In other words, the wires are arranged on a line connecting the low-beam filament 51 to the high-beam filament 52. This facilitates wiring of the above-mentioned wires.

[0064] Besides, the light source bulbs 500A and 500B in this variation example have a rear-end sealed part 53 whose planiform portion (pinched portion) 53C is placed on the line connecting the low-beam filament 51 to the high-beam filament 52. Therefore, this rear-end sealed part 53 can be formed by squeeze from both the right and left sides of the line connecting the low-beam filament 51 to the high-beam filament 52, which facilitates manufacture of the light source bulbs 500A and 500B.

[0065] Moreover, the light source bulbs 500 A and 500B in this variation example employ a light source bulb having the bridge 57 contained in the rear-end sealed part 53. This eliminates the light quantity loss resulting from the bridge 57, and provides a larger space within the glass envelope 50 to avoid interference in the cycle efficiency of filler gases such halogen gas.

[0066] While in the embodiments of the present invention described above the first, second, and third support wires SW1, SW2, and SW3 are fixed to a bridge 57, this bridge 57 may be omitted in consideration of the manufacturing facility of the light source bulbs.

[0067] In addition, since the prescribed low-beam distribution pattern LP and high-beam distribution pattern HP are controlled and formed by means of the entire-surface reflection light distribution of the reflecting surface 40, the lens 2 may be a plain glass or a lens comprising a diffusion system optical element group (so-called diffusion system prism element group) and the like.

[0068] Besides, while description has been made on

the examples where the lamp housing 1 and the reflector 4 having the reflecting surface 40 are separate from each other, the light source bulbs 500, 500A, and 500B of the present invention are applicable to those having a lamp housing integral with the reflector.

[0069] Particularly, the light source bulbs 500, 500A, and 500B of the present invention may sometimes be used exclusively for a left-traffic or a right-traffic light source bulb. Even in this case, they fall within the scope of the light source bulbs of the present invention.

[0070] While there has been described what are at present considered to be preferred embodiments of the invention, it will be understood that various modifications may be made thereto, and it is intended that the appended claims cover all such modifications as fall within the true spirit and scope of the invention.

Claims

1. A light source bulb (500A) in an automotive headlamp, said automotive headlamp having a lamp chamber (3) defined by a lamp housing (1) and a lens (2), said lamp chamber (3) having a reflector (40) and said light source bulb (500A) arranged therein,

   said reflector (4) including a reflecting surface (40) constituted by a complex reflecting surface and having a through hole (41) for insertion of said light source bulb (500A),

   said light source bulb (500A) having a high-beam filament (52) arranged obliquely below with respect to a low-beam filament (51),

   a prescribed low beam distribution pattern being formed by entire-surface reflection light distribution control of said reflecting surface (40) when said low-beam filament (51) is lit, a prescribed high beam distribution pattern being formed by the entire-surface reflection control of said reflecting surface (40) when said high-beam filament (50) is lit, wherein

   said light source bulb (500A) has said low-beam filament (51) and said high-beam filament (52) enclosed in a glass envelope (50), a rear end part (53) of said glass envelope (50) being sealed at portions on both a right and left sides with respect to a line connecting said low-beam filament to said high-beam filament, said rear-end part comprising curve-deformed portions (53L, 53R),

characterized in that

a boundary (59) between a middle envelope part and the rear-end sealed part (53) of said glass envelope (50) is positioned behind a line (L50) connecting a corner (52BU) formed between the rear end and upper end of said high-beam filament (52) to a corner of the inner periphery of said through hole (41) for insertion in said reflector (14).

2. A light source bulb (500B) in an automotive headlamp, said automotive headlamp having a lamp chamber (3) defined by a lamp housing (1) and a lens (2), said lamp chamber (3) having a reflector (4) and said light source bulb (500B) arranged therein,

   said reflector (4) including a reflecting surface (40) constituted by a complex reflecting surface (40) and having a through hole (41) for insertion of said light source bulb (500B),

   said light source bulb (500B) having a high-beam filament (52) arranged obliquely below a low-beam filament (51),

   a prescribed low beam distribution pattern being formed by entire-surface reflection light distribution control of said reflecting surface (40) when said low-beam filament (51) is lit, a prescribed high beam distribution pattern being formed by the entire-surface reflection control of said reflecting surface (40) when said high-beam filament (52) is lit, wherein

   said light source bulb (500B) has said low-beam filament (51) and said high-beam filament (52) enclosed in a glass envelope (50), a rear end part of said glass envelope being sealed at portions on both a right and left sides with respect to a line connecting said low-beam filament to said high-beam filament, said rear-end part comprising curve-deformed portions (53L, 53R),

   characterized in that

   a boundary between a middle envelope part and the rear-end sealed part (53) of said glass envelope (50) is positioned behind a line (L70) connecting a corner (51BU) formed between the rear end and upper end of said low-beam filament (51) to a corner of the inner periphery of said through hole (41) for insertion in said reflector (4).

3. The light source bulb (500A, 500B) in an automotive headlamp according to claim 1 or 2 wherein: said low-beam filament (51) and said high beam filament (52) are supported by a lead wire and a support wire; and said lead wire and said support wire are arranged on a line connecting said low-beam filament to said high-beam filament.

4. The light source bulb in an automotive headlamp according to claim 1 or 2 wherein: said low-beam filament (51) and said high beam filament (52) are supported by a lead wire and a support wire; said support wire is supported by a bridge; and said bridge is arranged in the rear-end sealed part (53) of said glass envelope (50).

Patentansprüche

1. Eine Glühbirne (500A) in einem Autoscheinwerfer, wobei der Autoscheinwerfer eine durch ein Lampengehäuse (1) und eine Linse (2) definierte Lampenkammer (3) aufweist, die Lampenkammer (3) einen Reflektor (4) aufweist und die Glühbirne (500A) darin angeordnet ist,
der Reflektor (4) eine durch eine komplexe reflektierende Oberfläche gebildete reflektierende Oberfläche (40) einschließt und eine Öffnung (41) zum Einsetzen der Glühbirne (500A) aufweist,
die Glühbirne (500A) einen schräg unterhalb bezüglich eines Abblendlicht-Glühfadens (51) angeordneten Fernlicht-Glühfaden (52) aufweist,
ein vorgeschriebenes Abblendlicht-Verteilungsmuster durch Lichtverteilungssteuerung der gesamten Oberflächenreflexion der reflektierenden Oberfläche (40) gebildet wird, wenn der Abblendlicht-Glühfaden (51) eingeschaltet wird, ein vorgeschriebenes Fernlicht-Verteilungsmuster durch Lichtverteilungssteuerung der gesamten Oberflächenreflexion der reflektierenden Oberfläche (40) gebildet wird, wenn der Fernlicht-Glühfaden (50) eingeschaltet wird, wobei
die Glühbirne (500A) den Abblendlicht-Glühfaden (51) und den Fernlicht-Glühfaden (52) in einer Glashülle (50) eingeschlossen aufweist, ein hinterer Teil (53) der Glashülle (50) an Bereichen sowohl auf einer rechten als auch einer linken Seite bezüglich einer Linie, die den Abblendlicht-Glühfaden mit dem Fernlicht-Glühfaden verbindet, versiegelt ist, der hintere Teil kurvenförmig deformierte Bereiche (53L, 53R) aufweist,
dadurch gekennzeichnet, dass
eine Grenze (59) zwischen einem mittleren Hüllenteil und dem hinteren versiegelten Teil (53) der Glashülle (50) hinter einer Linie (L50), die eine zwischen dem hinteren Ende und dem oberen Ende des Femlicht-Glühfadens (52) gebildete Ecke mit einer Ecke des inneren Rands der Öffnung (41) zum Einsetzen in den Reflektor (14) verbindet, angeordnet ist.

2. Eine Glühbirne (500B) in einem Autoscheinwerfer, wobei der Autoscheinwerfer eine durch ein Lampengehäuse (1) und eine Linse (2) definierte Lampenkammer (3) aufweist, die Lampenkammer (3) einen Reflektor (4) aufweist und die Glühbirne (500B) darin angeordnet ist,
der Reflektor (4) eine durch eine komplexe reflektierende Oberfläche (40) gebildete reflektierende Oberfläche (40) einschließt und eine Öffnung (41) zum Einsetzen der Glühbirne (500B) aufweist,
die Glühbirne (500B) einen schräg unterhalb eines Abblendlicht-Glühfadens (51) angeordneten Fernlicht-Glühfaden (52) aufweist,
ein vorgeschriebenes Abblendlicht-Verteilungsmuster durch Lichtverteilungssteuerung der gesamten Oberflächenreflexion der reflektierenden Oberfläche (40) gebildet wird, wenn der Abblendlicht-Glühfaden (51) eingeschaltet wird, ein vorgeschriebenes Fernlicht-Verteilungsmuster durch Lichtverteilungssteuerung der gesamten Oberflächenreflexion der reflektierenden Oberfläche (40) gebildet wird, wenn der Fernlicht-Glühfaden (52) eingeschaltet wird, wobei
die Glühbirne (500B) den Abblendlicht-Glühfaden (51) und den Fernlicht-Glühfaden (52) in eine Glashülle (50) eingeschlossen aufweist, ein hinterer Teil der Glashülle an Bereichen sowohl an rechten als auch linken Seiten bezüglich einer Linie, die den Abblendlicht-Glühfaden mit dem Fernlicht-Glühfaden verbindet, versiegelt ist, der hintere Teil kurvenförmig deformierte Bereiche (53L, 53R) umfasst,
dadurch gekennzeichnet, dass
eine Grenze zwischen einem mittleren Hüllenteil und dem hinteren versiegelten Teil (53) der Glashülle (50) hinter einer Linie (L70), die eine zwischen dem hinteren Ende und dem oberen Ende des Abblendlicht-Glühfadens (51) gebildete Ecke (51BU) mit einer Ecke des inneren Rands der Öffnung (41) zum Einsetzen in den Reflektor (4) verbindet, angeordnet ist.

3. Die Glühbirne (500A, 500B) in einem Autoscheinwerfer nach Anspruch 1 oder 2, wobei: der Abblendlicht-Glühfaden (51) und der Fernlicht-Glühfaden (52) von einem Zuleitungsdraht und einem Haltedraht unterstützt werden; und der Zuleitungsdraht und der Haltedraht auf einer Linie, die den Abblendlicht-Glühfaden mit dem Fernlicht-Glühfaden verbindet, angeordnet sind.

4. Die Glühbirne in einem Autoscheinwerfer nach Anspruch 1 oder 2, wobei: der Abblendlicht-Glühfaden (51) und der Fernlicht-Glühfaden (52) von einem Zuleitungsdraht und einem Haltedraht unterstützt werden; der Haltedraht von einer Brücke unterstützt wird; und die Brücke in dem hinteren versiegelten Teil (53) der Glashülle (50) angeordnet ist.

Revendications

1. Ampoule de source lumineuse (500A) d'un phare d'automobile, ledit phare d'automobile ayant une chambre de lampe (3) définie par une enceinte de lampe (1) et une lentille (2), ladite chambre de lampe (3) ayant un réflecteur (4), et ladite ampoule de source lumineuse (500A) agencée à l'intérieur,
ledit réflecteur (4) comportant une surface réflectrice (40) constituée d'une surface réflectrice complexe et ayant un trou traversant d'insertion (41) pour l'insertion de ladite ampoule de source lumineuse (500A),

ladite ampoule de source lumineuse (500A) ayant un filament de faisceau haut (52) agencé de manière oblique en dessous d'un filament de faisceau bas (51),

un motif de distribution de faisceau bas prescrit étant formé par une commande de distribution de lumière de réflexion de surface entière de ladite surface réflectrice (40) lorsque ledit filament de faisceau bas (51) est allumé, un motif de distribution de faisceau haut prescrit étant formé par la commande de surface entière de ladite surface réflectrice (40) lorsque ledit filament de faisceau haut (52) est allumé,

ladite ampoule de source lumineuse (500A) ayant ledit filament de faisceau bas (51) et ledit filament de faisceau haut (52) enfermés dans une enveloppe en verre (50), une partie d'extrémité arrière (53) de ladite enveloppe en verre (50) étant scellée en des parties situées sur les deux côtés droit et gauche par rapport à une ligne reliant ledit filament de faisceau bas audit filament de faisceau haut, ladite partie d'extrémité arrière comportant des parties déformées en courbe (53R, 53L),

caractérisé en ce que

une frontière (59) entre une partie d'enveloppe médiane et la partie scellée d'extrémité arrière (53) de l'enveloppe en verre (50) est positionnée derrière une ligne (L50) reliant un coin (52BU) formé entre l'extrémité arrière et l'extrémité supérieure dudit filament de faisceau haut (52) à un coin de la périphérie intérieure dudit trou traversant d'insertion (41) pour insertion dans ledit réflecteur (4).

2. Ampoule de source lumineuse (500B) d'un phare d'automobile, ledit phare d'automobile ayant une chambre de lampe (3) définie par une enceinte de lampe (1) et une lentille (2), ladite chambre de lampe (3) ayant un réflecteur (4), et ladite ampoule de source lumineuse (500B) agencée à l'intérieur,

ledit réflecteur (4) comportant une surface réflectrice (40) constituée d'une surface réflectrice (40) complexe et ayant un trou traversant d'insertion (41) pour l'insertion de ladite ampoule de source lumineuse (500B),

ladite ampoule de source lumineuse (500B) ayant un filament de faisceau haut (52) agencé de manière oblique en dessous d'un filament de faisceau bas (51),

un motif de distribution de faisceau bas prescrit étant formé par une commande de distribution de lumière de réflexion de surface entière de ladite surface réflectrice (40) lorsque ledit filament de faisceau bas (51) est allumé, un motif de distribution de faisceau haut prescrit étant formé par la commande de surface entière de ladite surface réflectrice (40) lorsque ledit filament de faisceau haut (52) est allumé,

ladite ampoule de source lumineuse (500B) ayant ledit filament de faisceau bas (51) et ledit filament de faisceau haut (52) enfermés dans une enveloppe en verre (50), une partie d'extrémité arrière de ladite enveloppe en verre (50) étant scellée en des parties situées sur les deux côtés droit et gauche par rapport à une ligne reliant ledit filament de faisceau bas audit filament de faisceau haut, ladite partie d'extrémité arrière comportant des parties déformées en courbe (53R, 53L),

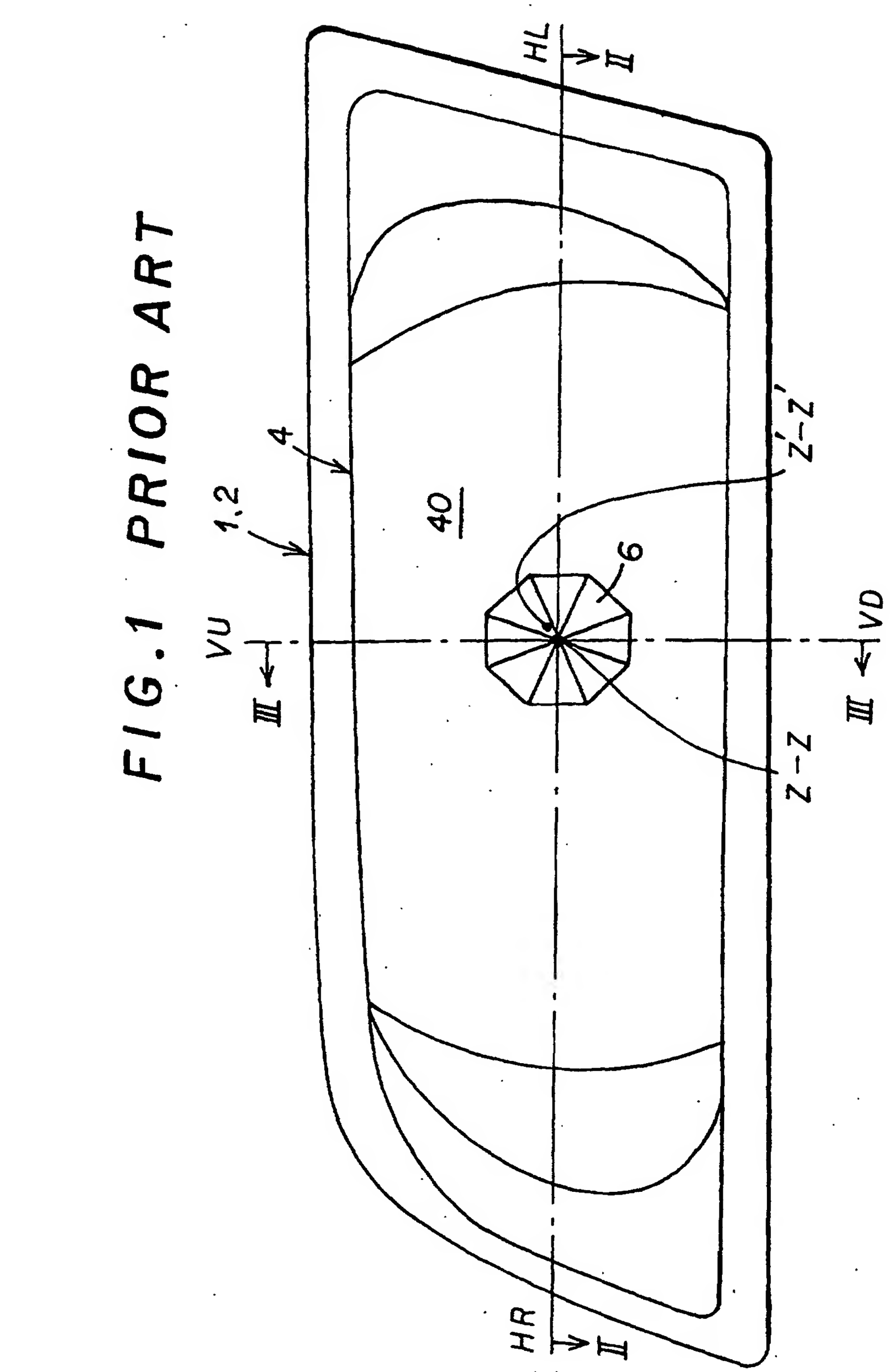
caractérisé en ce que

une frontière entre une partie d'enveloppe médiane et la partie scellée d'extrémité arrière (53) de l'enveloppe en verre (50) est positionnée derrière une ligne (L70) reliant un coin (51BU) formé entre l'extrémité arrière et l'extrémité supérieuré dudit filament de faisceau bas (51) à un coin de la périphérie intérieure dudit trou traversant d'insertion (41) pour insertion dans ledit réflecteur (4).

3. Ampoule de source lumineuse (500A, 500B) d'un phare d'automobile selon la revendication 1 ou 2, dans laquelle : ledit filament de faisceau bas (51) et ledit filament de faisceau haut (52) sont supportés par un fil conducteur et un fil de support ; et ledit fil conducteur et ledit fil de support sont agencés sur une ligne reliant ledit filament de faisceau bas audit filament de faisceau haut.

4. Ampoule de source lumineuse d'un phare d'automobile selon la revendication 1 ou 2, dans laquelle : ledit filament de faisceau bas (51) et ledit filament de faisceau haut (52) sont supportés par un fil conducteur et un fil de support ; ledit fil de support est supporté par un pont ; et ledit pont est agencé dans la partie scellée d'extrémité arrière (53) de ladite enveloppe en verre (50).

FIG.1 PRIOR ART



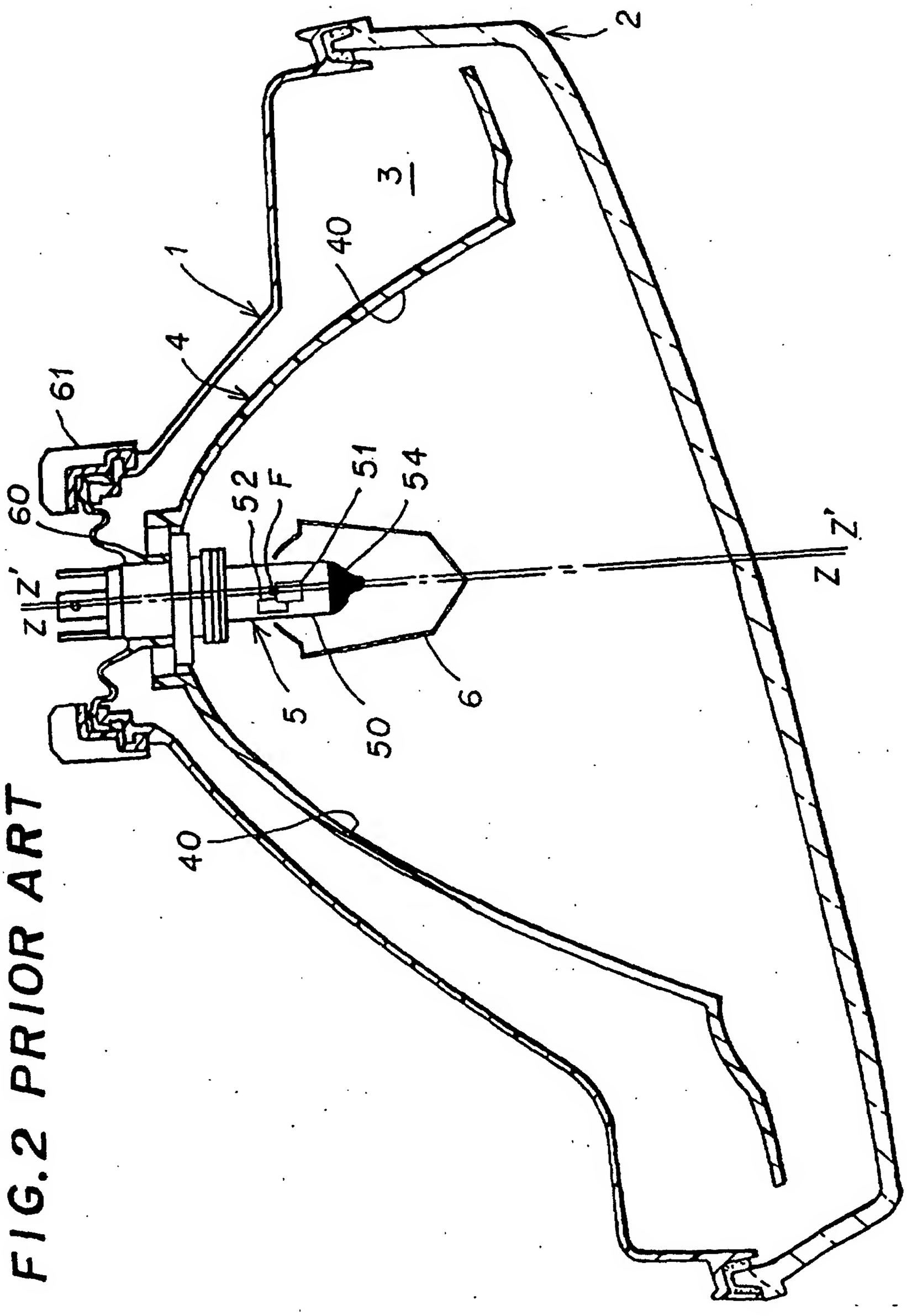


FIG.2 PRIOR ART

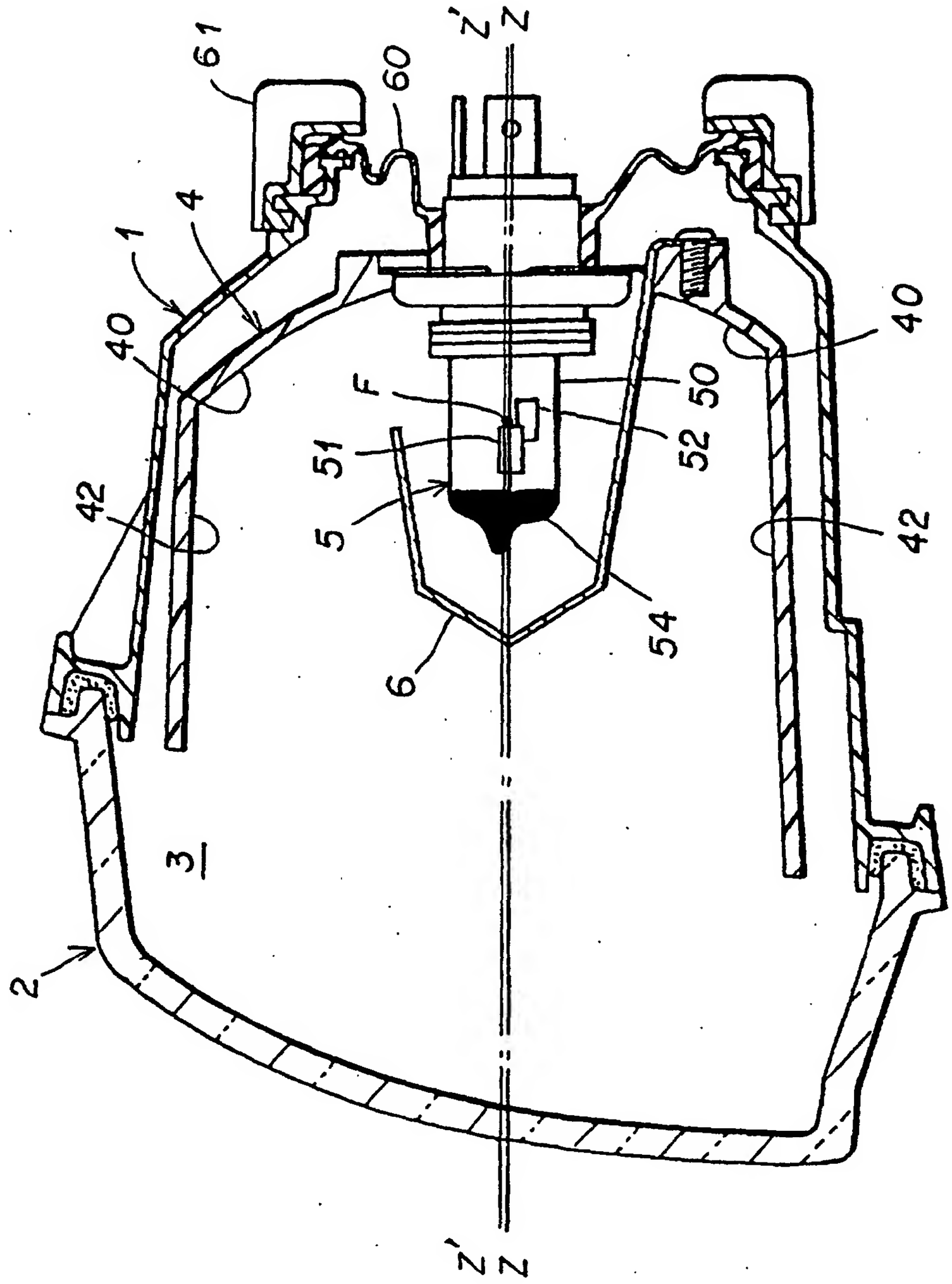


FIG.3 PRIOR ART

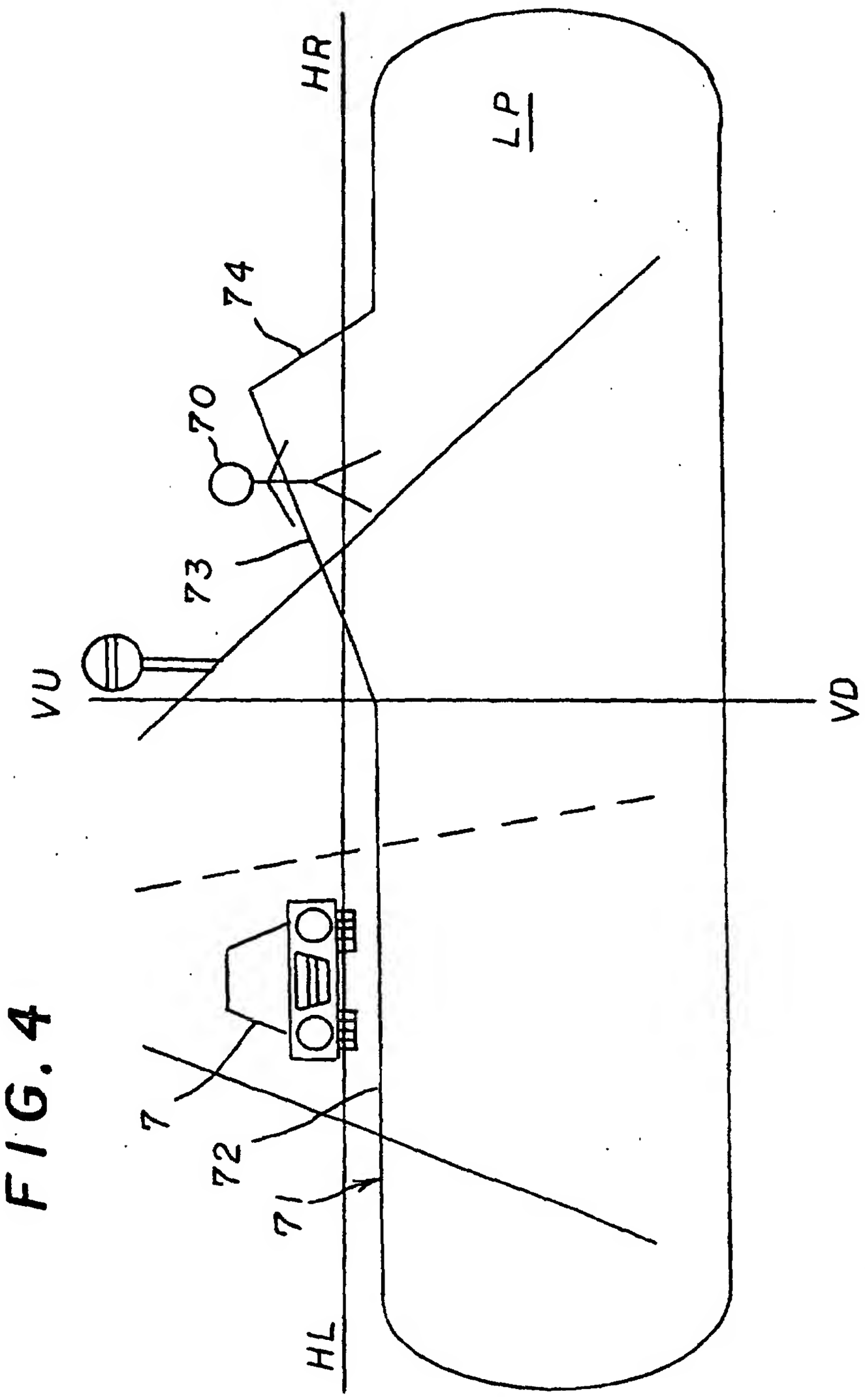


FIG. 4

FIG.5

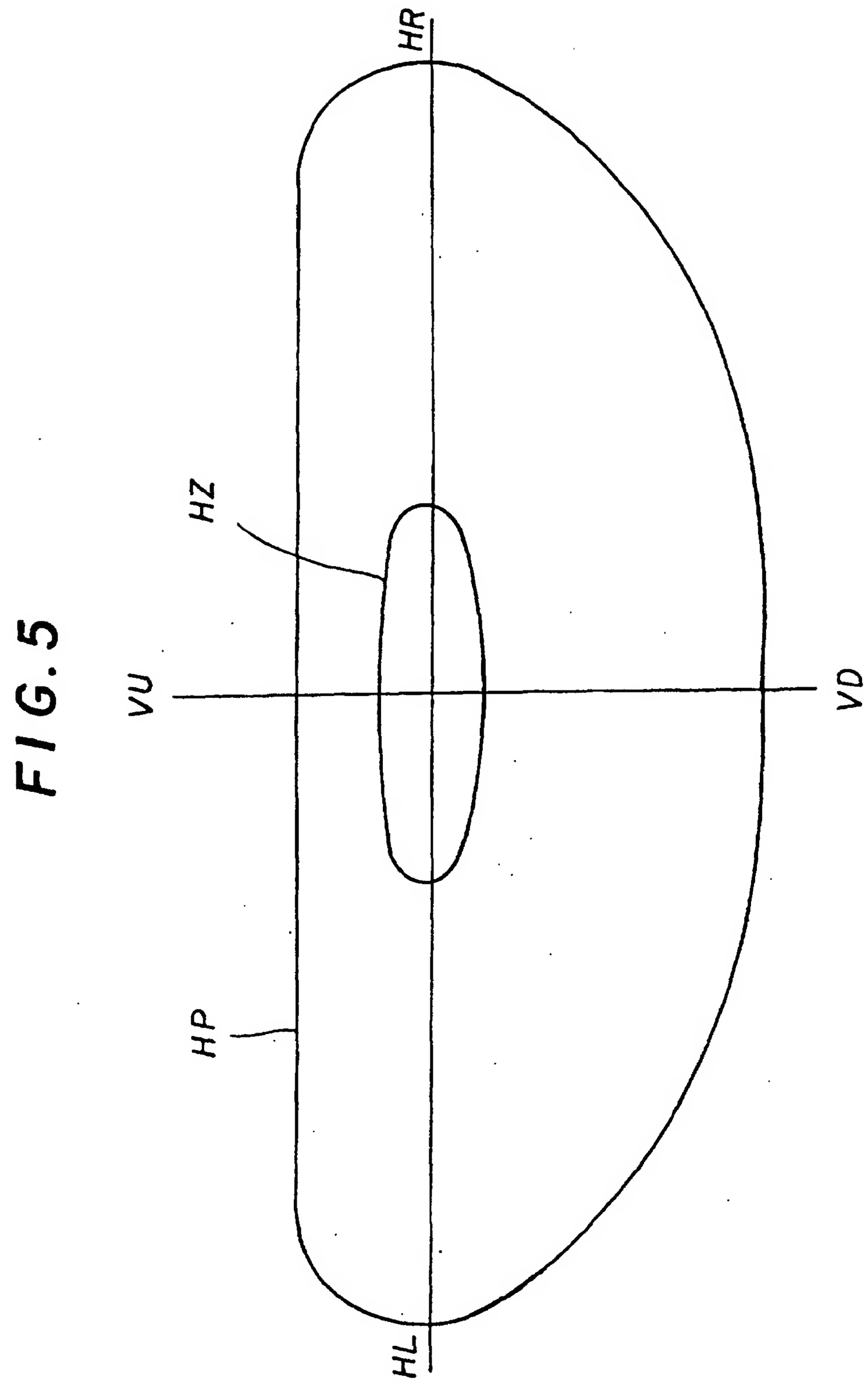


FIG.6C
PRIOR ART

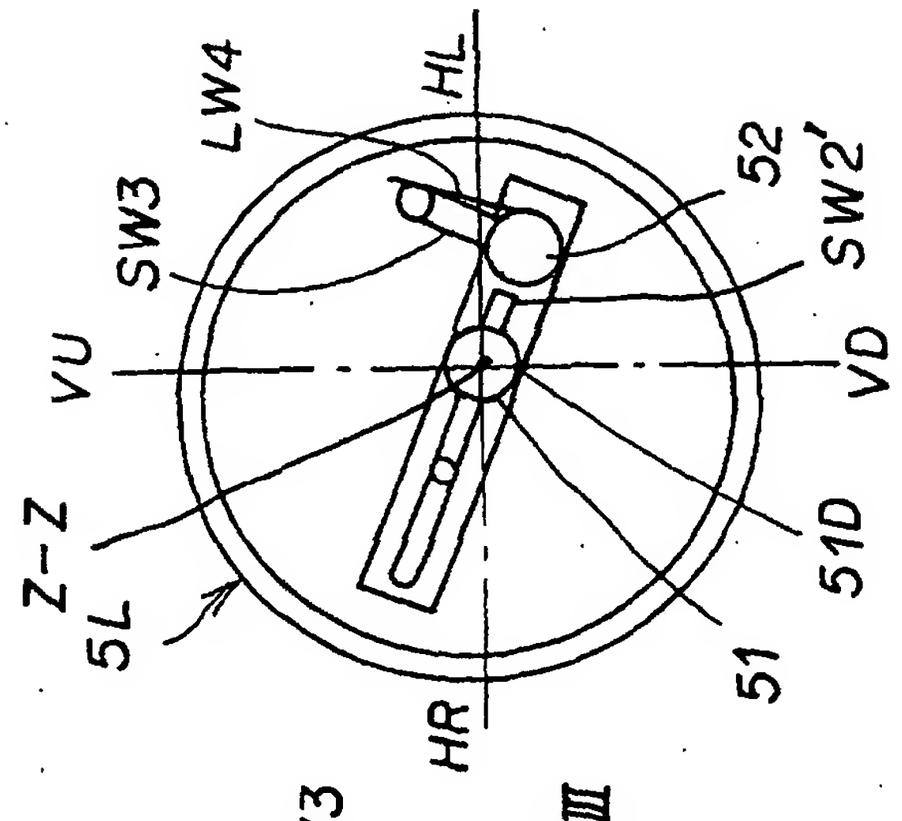


FIG.6B
PRIOR ART

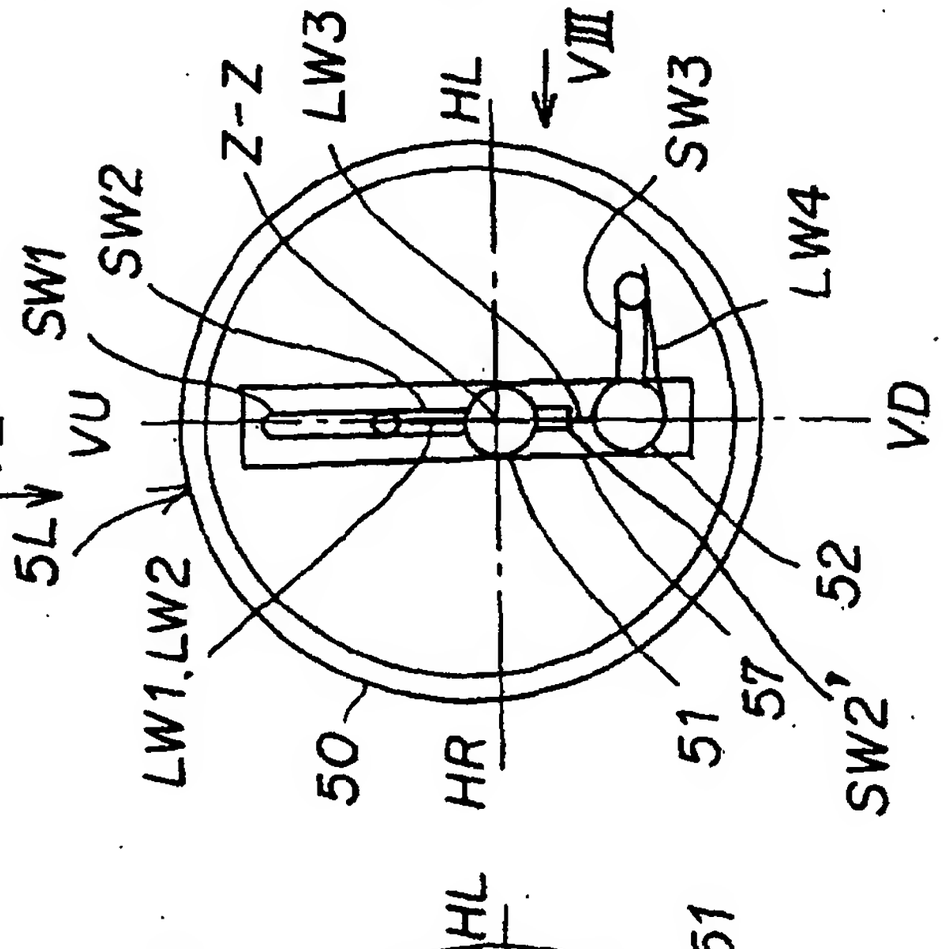


FIG.6A
PRIOR ART

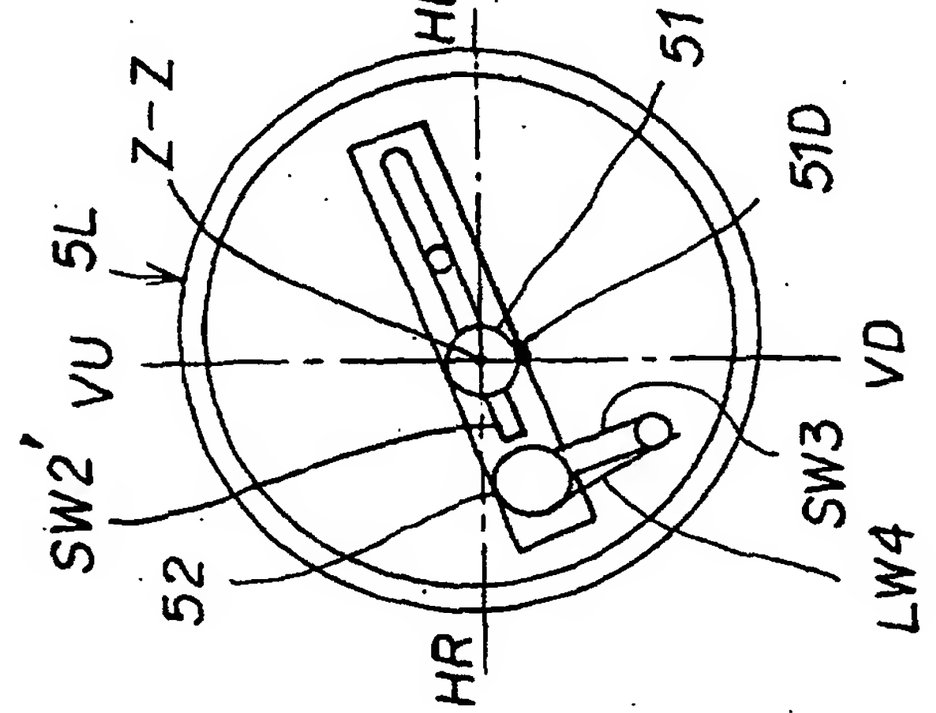


FIG.7 PRIOR ART

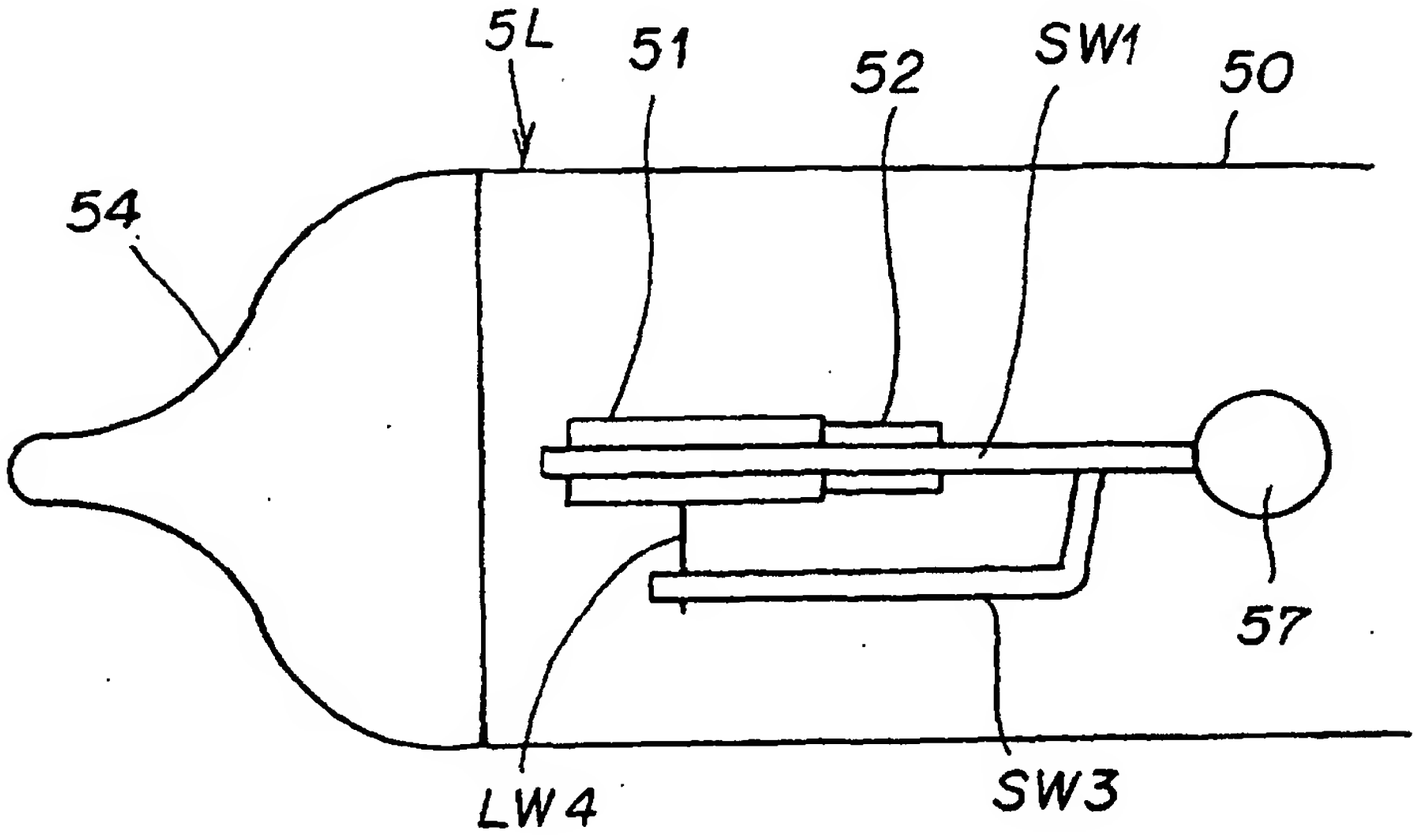


FIG.8 PRIOR ART

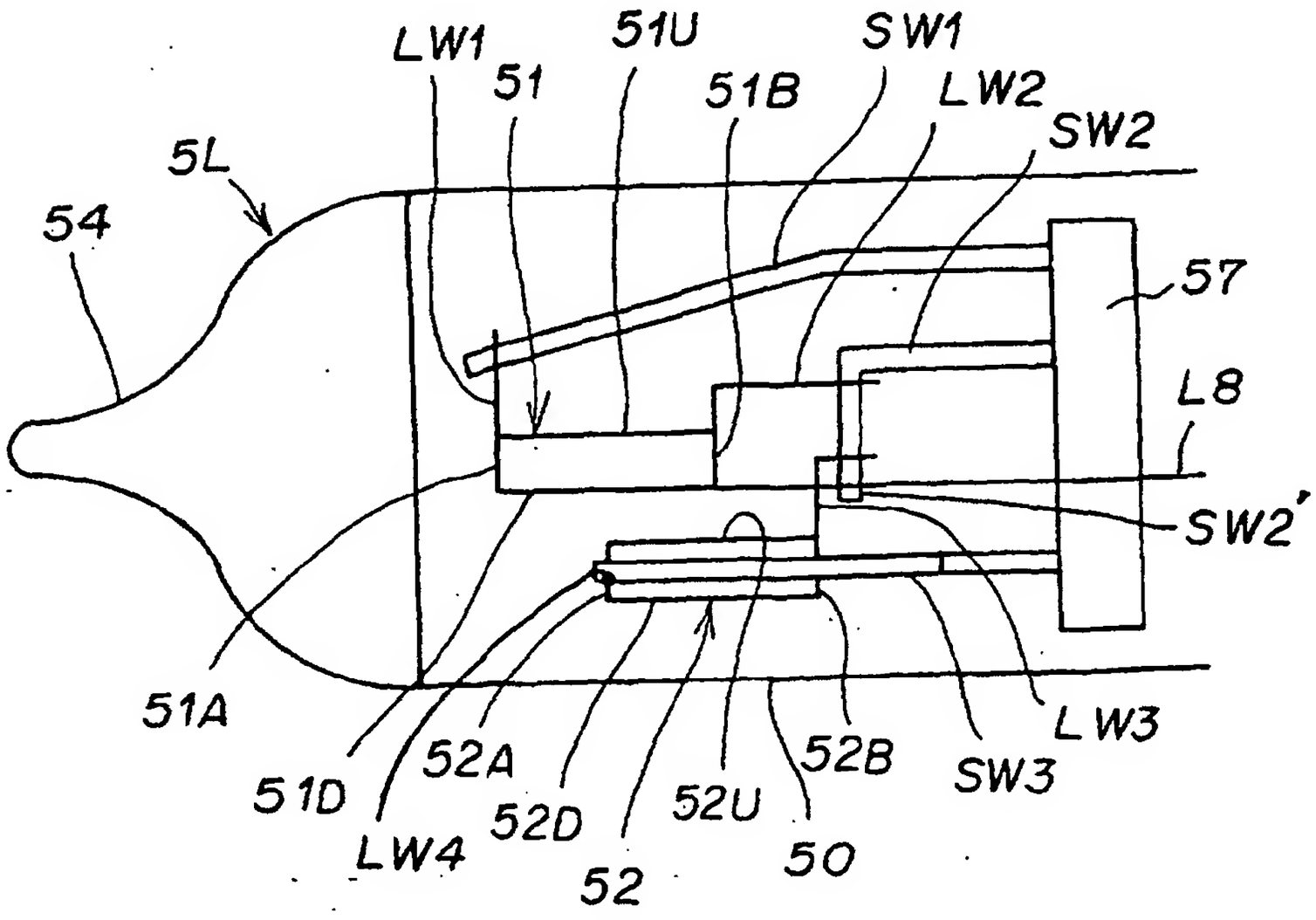


FIG.9 PRIOR ART

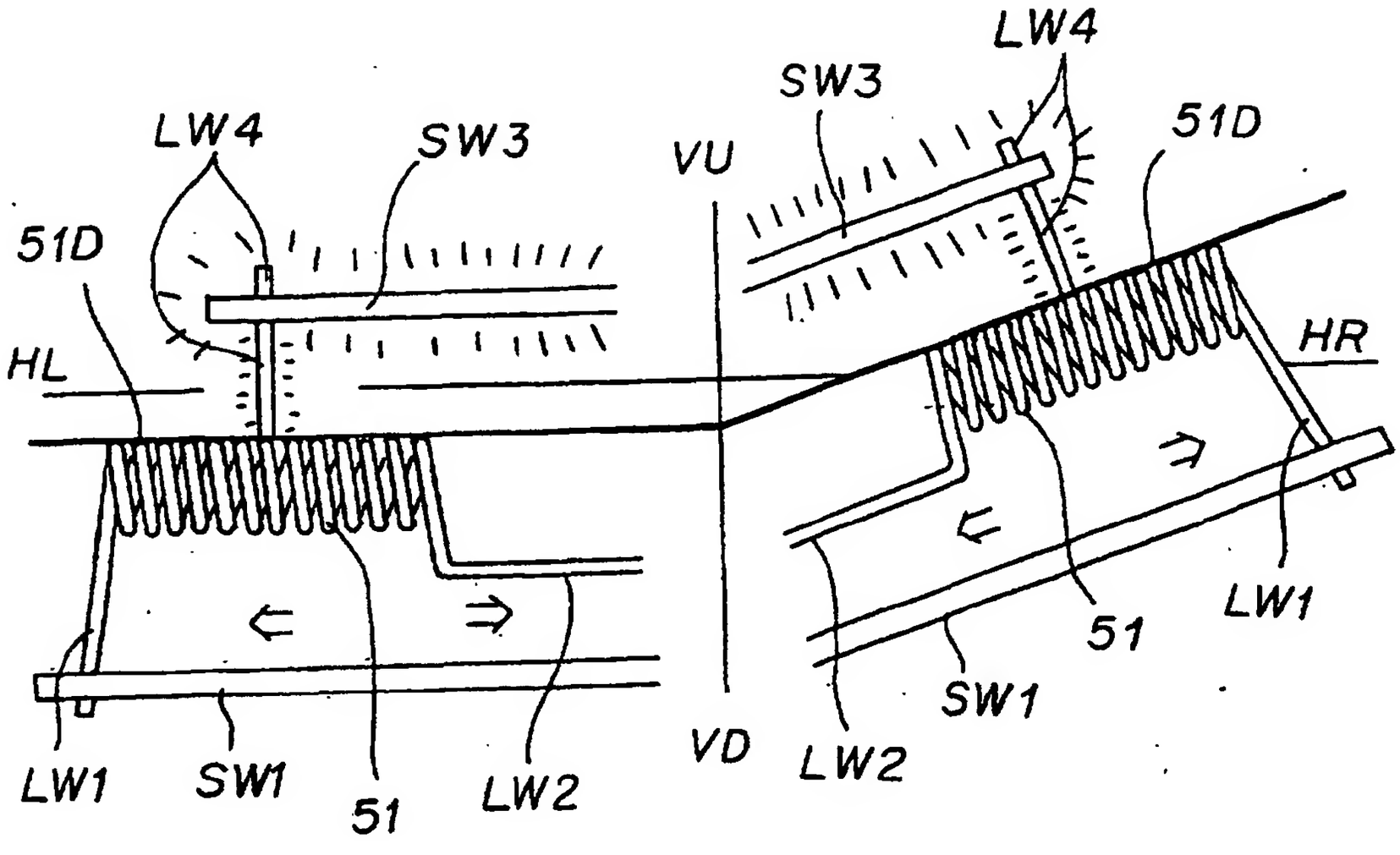


FIG.10 PRIOR ART

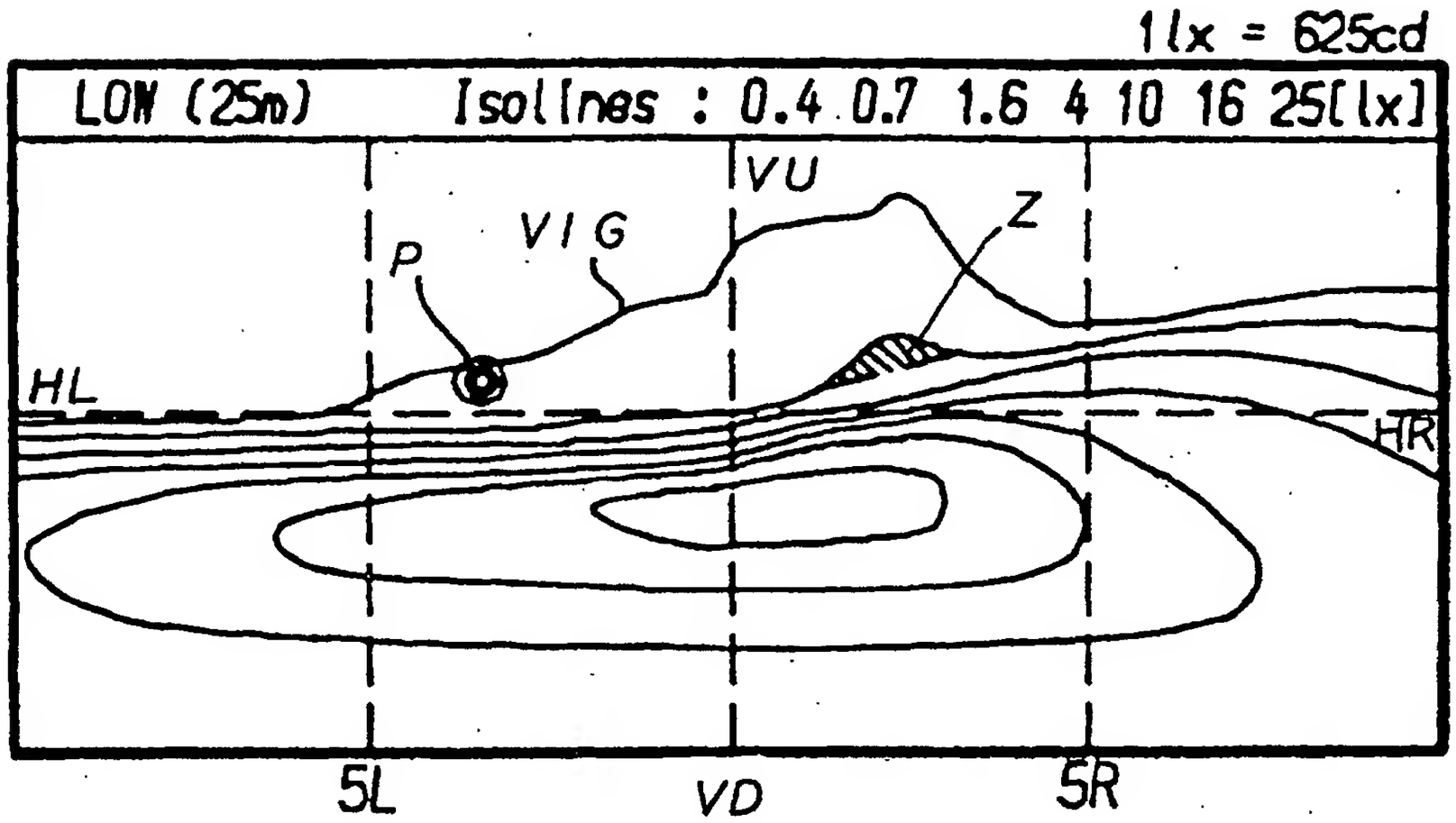


FIG.11C
PRIOR ART

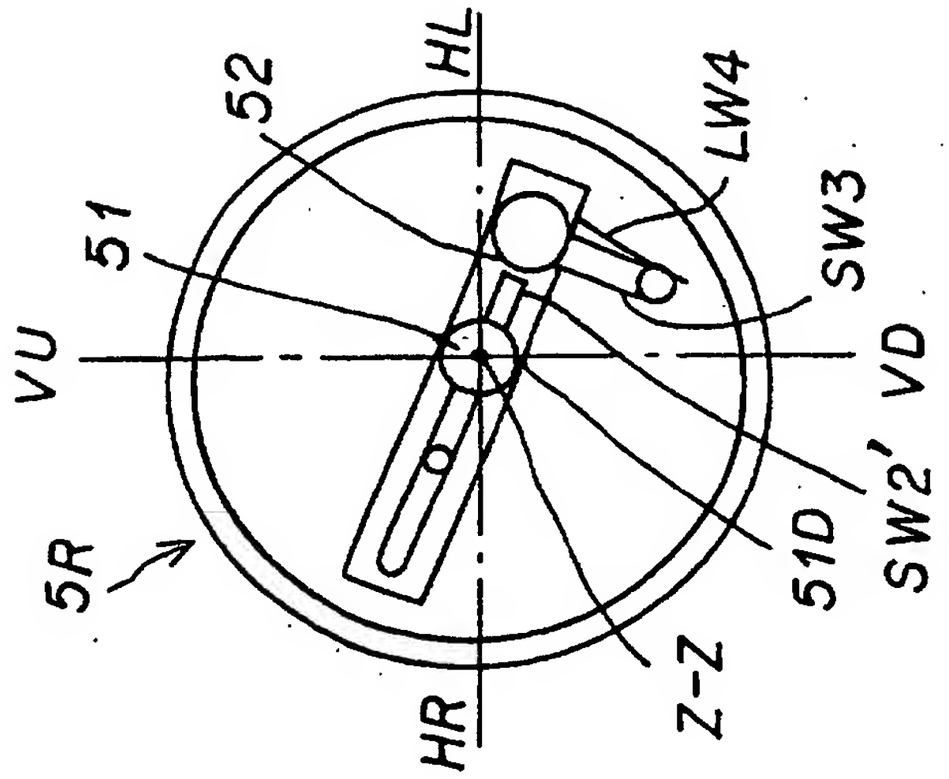


FIG.11B
PRIOR ART

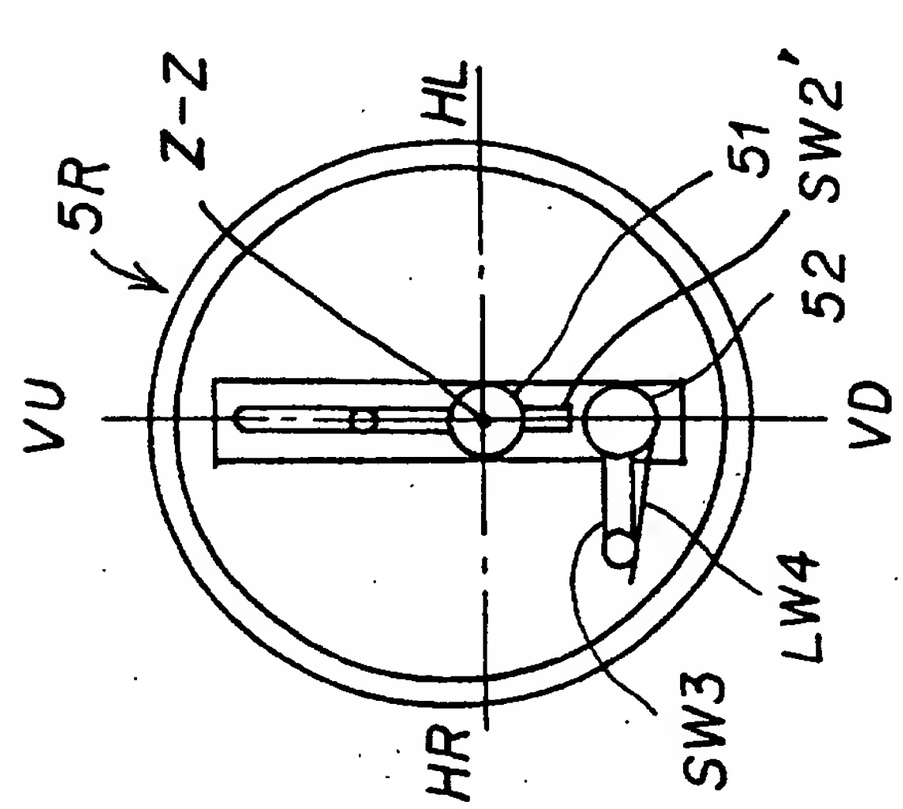
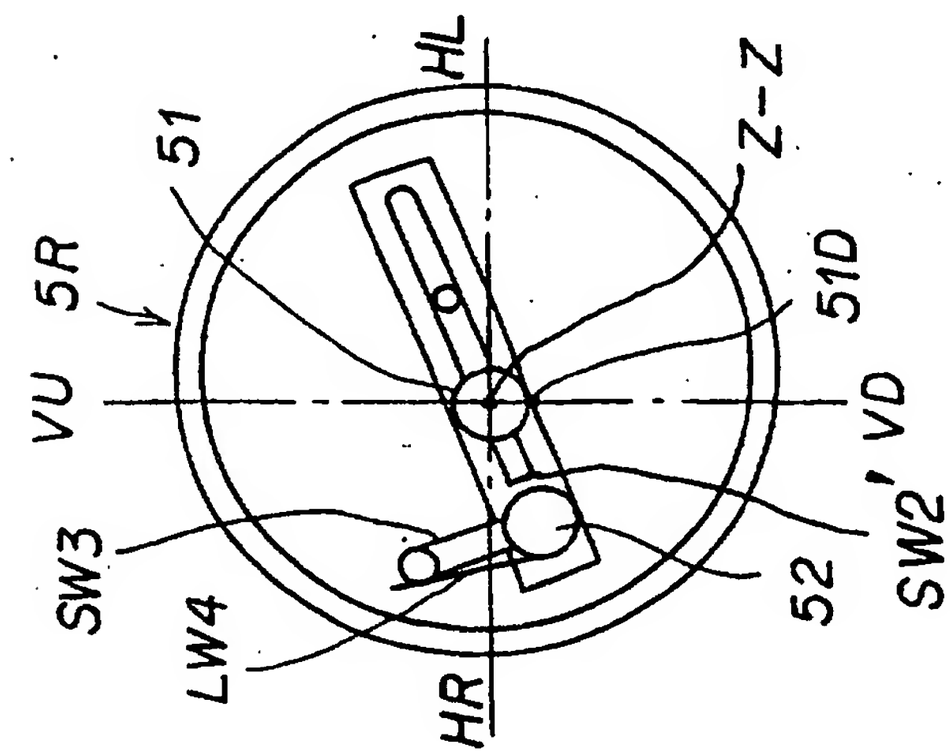
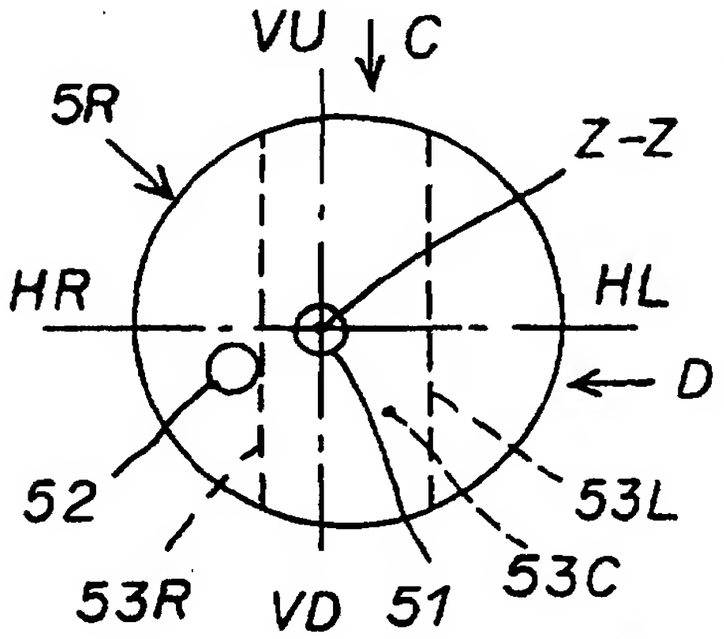


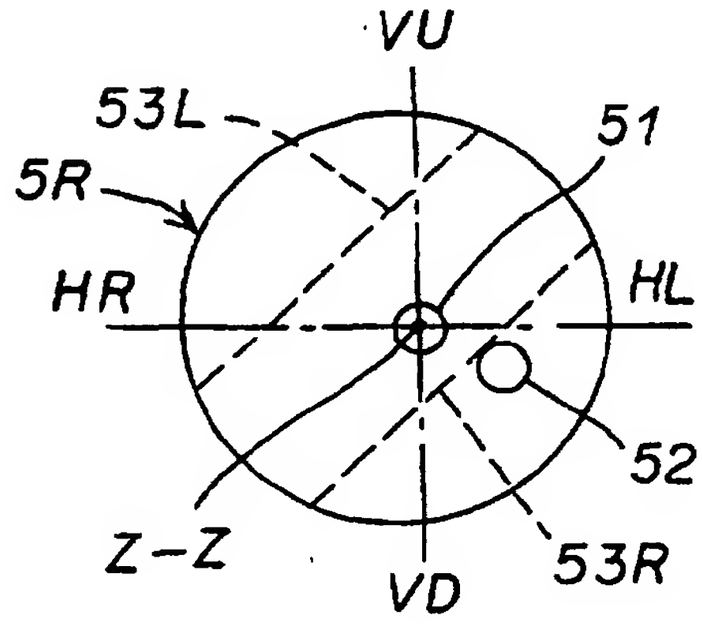
FIG.11A
PRIOR ART



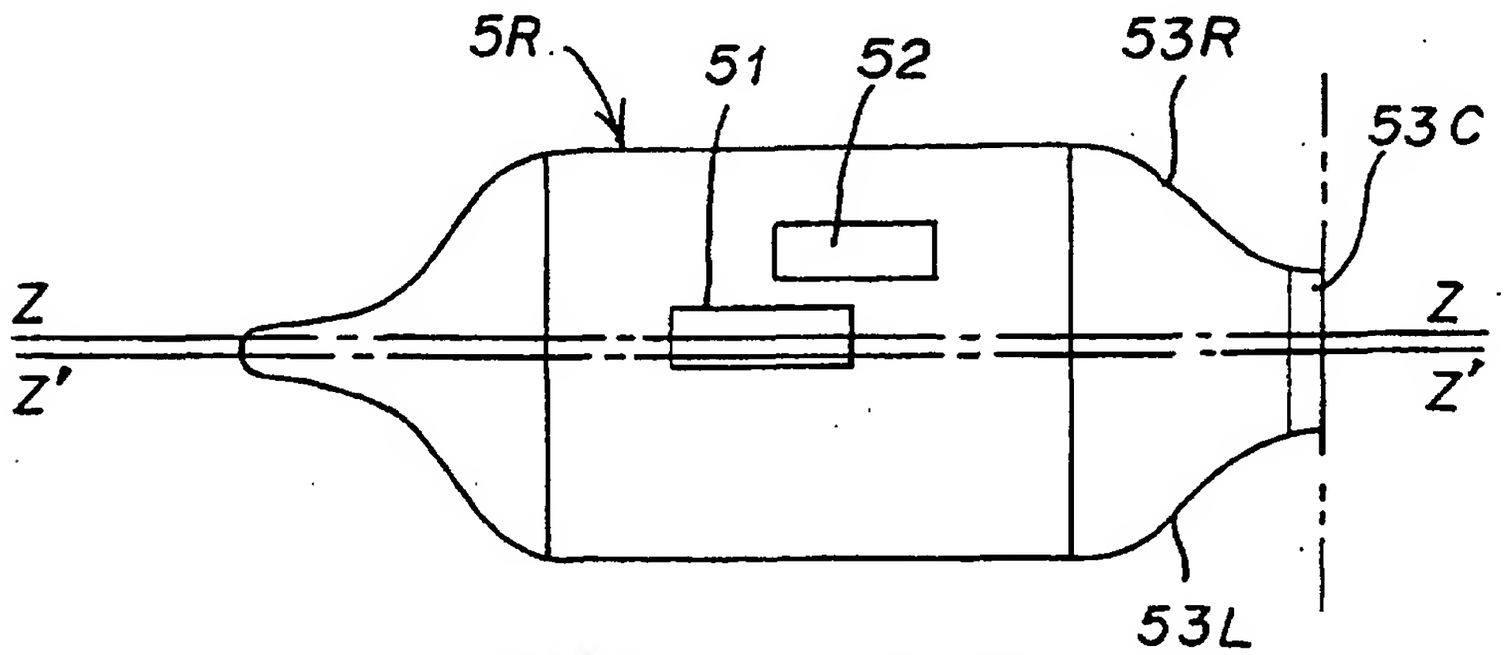
PRIOR ART
FIG.12A



PRIOR ART
FIG.12B



PRIOR ART
FIG.12C



PRIOR ART
FIG.12D

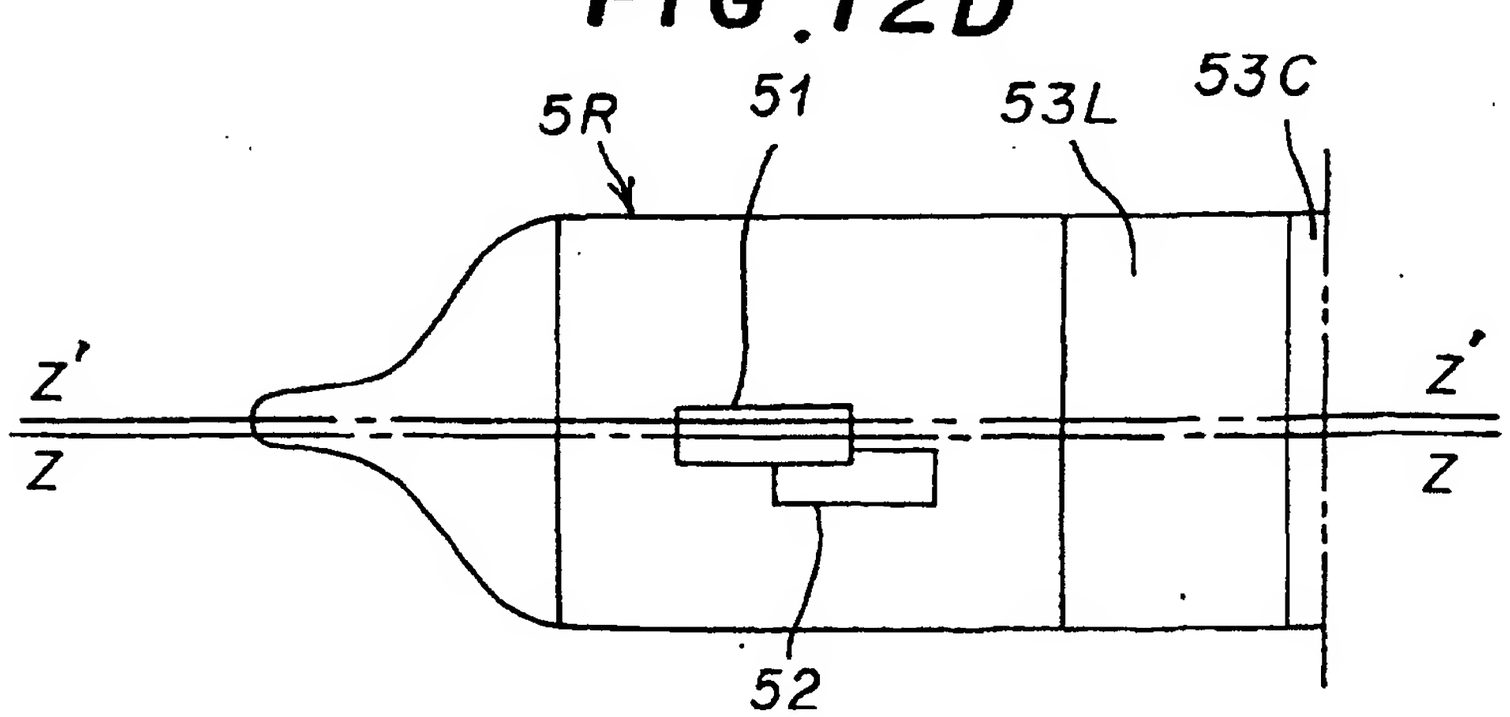


FIG.13 PRIOR ART

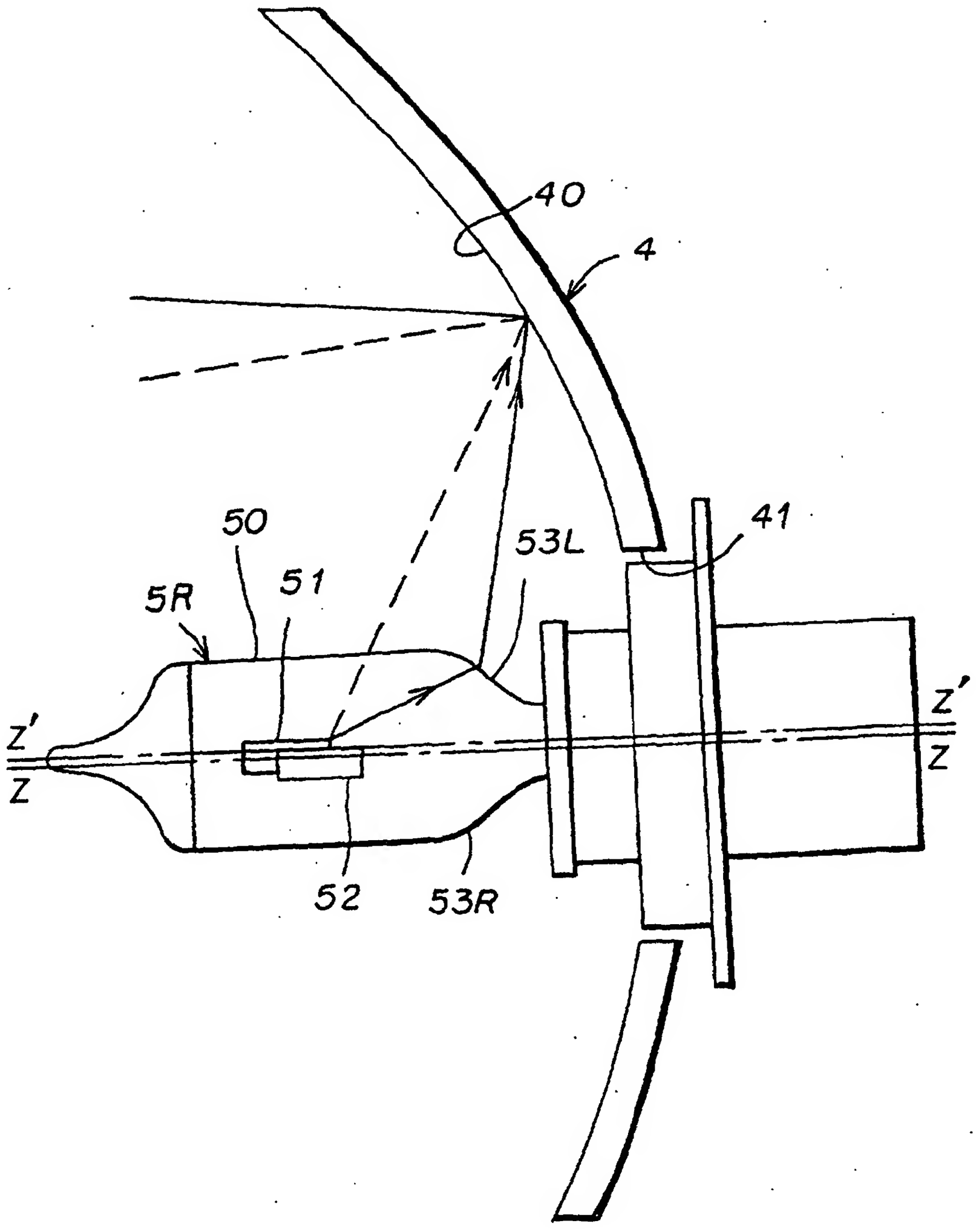
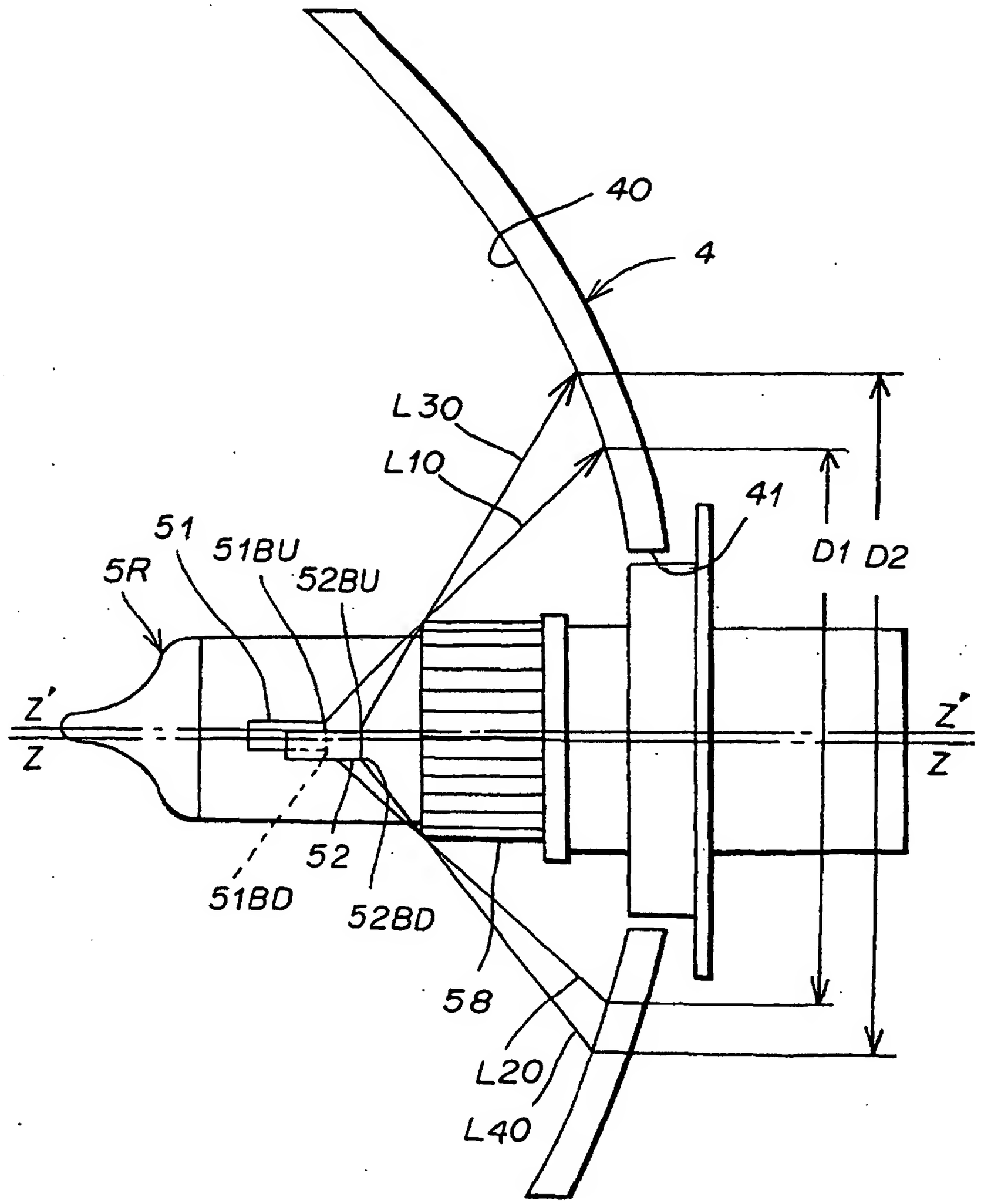
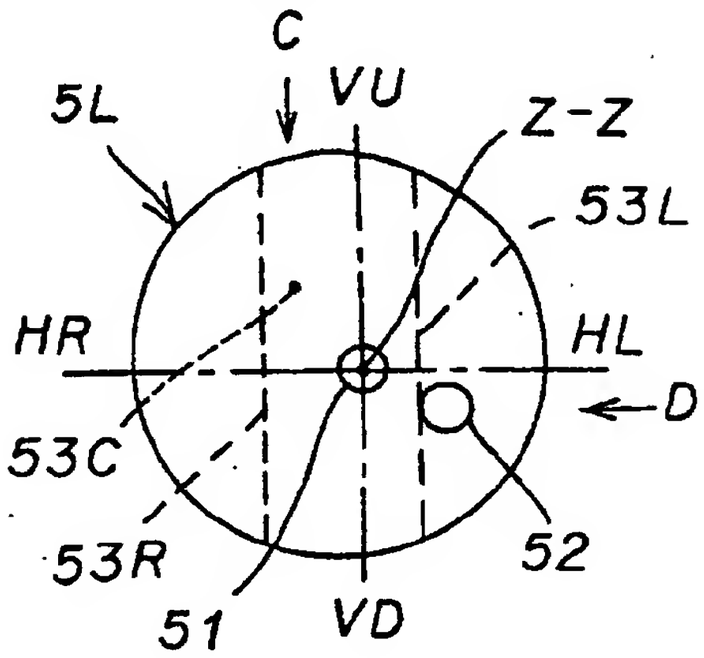


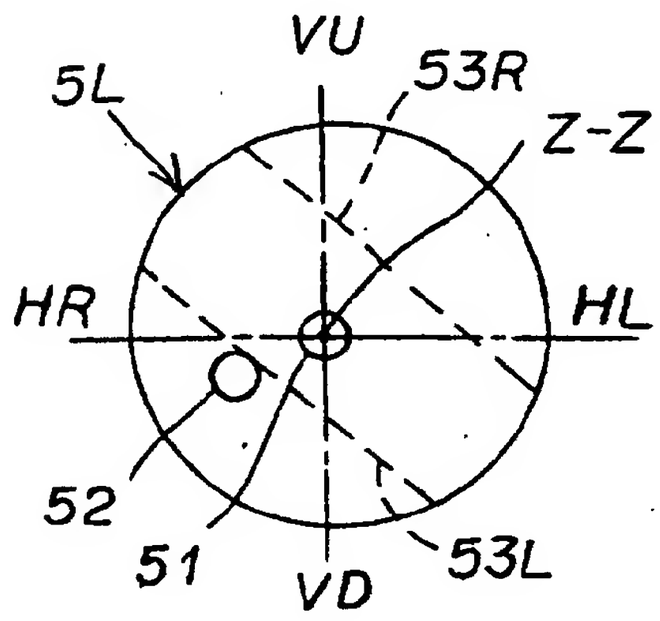
FIG.14 PRIOR ART



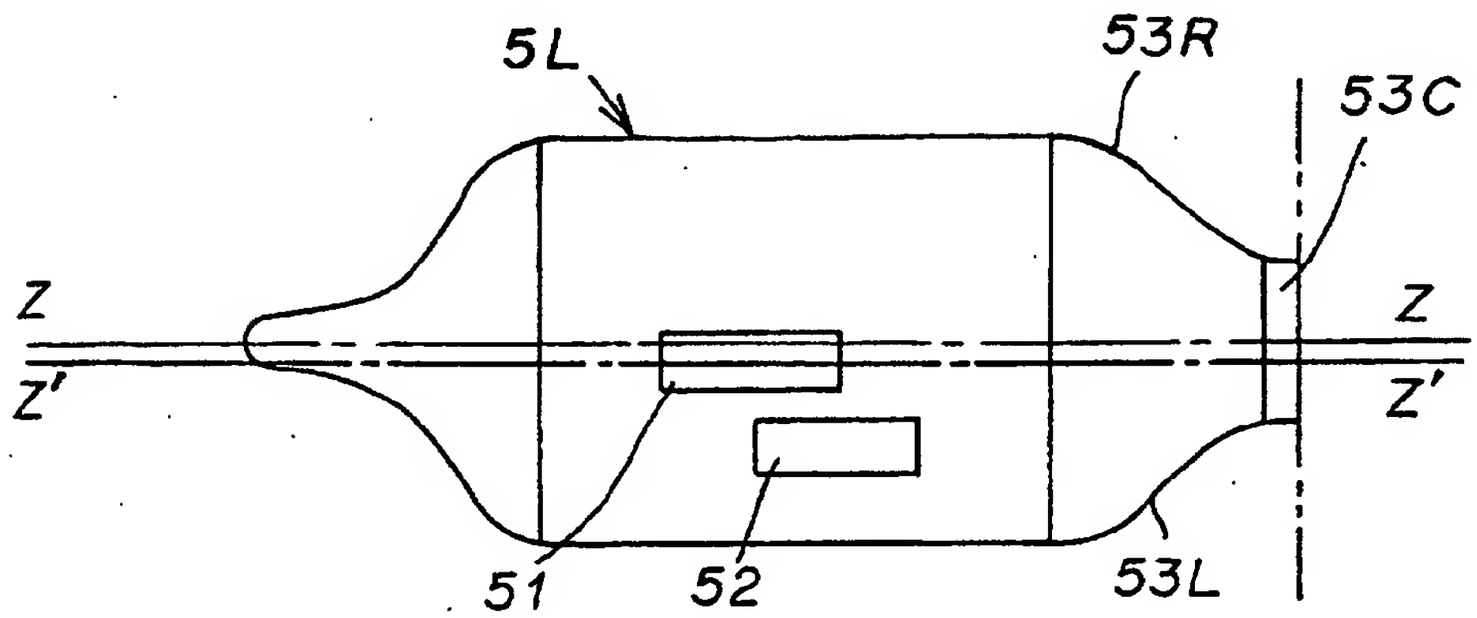
PRIOR ART
FIG.15A



PRIOR ART
FIG.15B



PRIOR ART
FIG.15C



PRIOR ART
FIG.15D

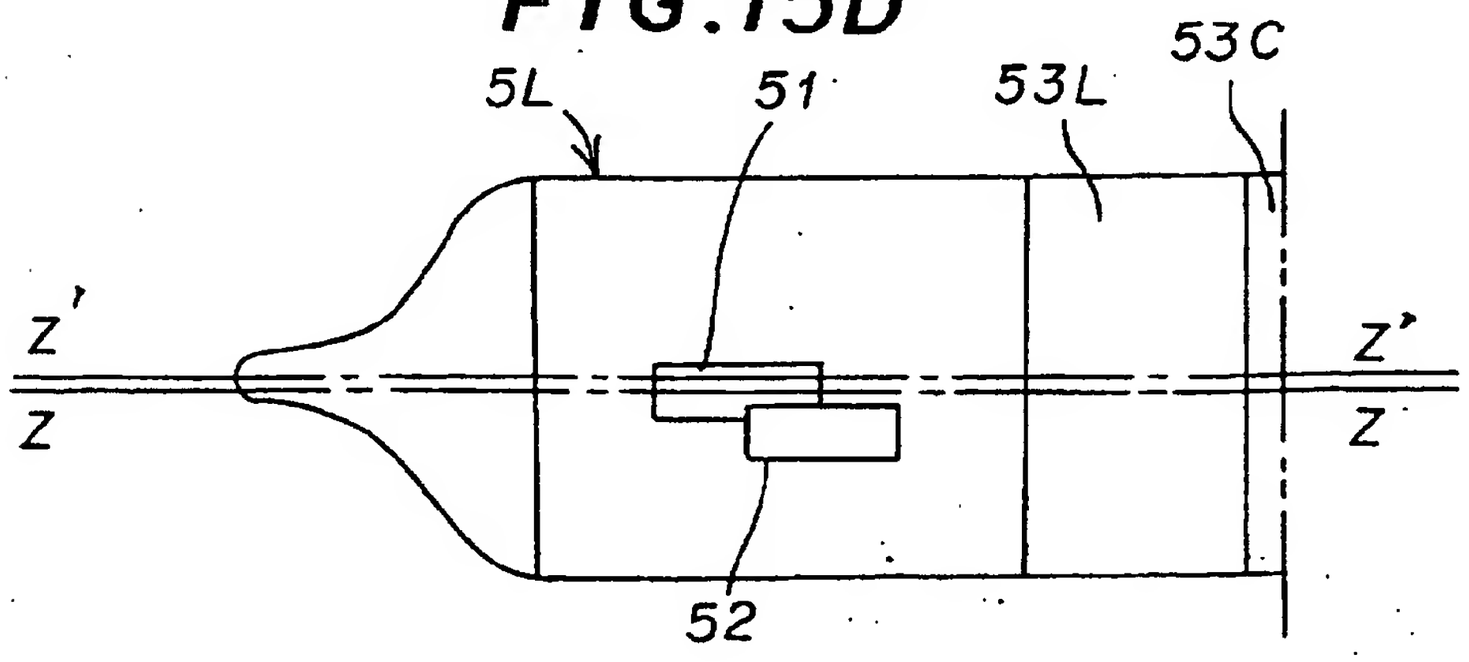


FIG. 16

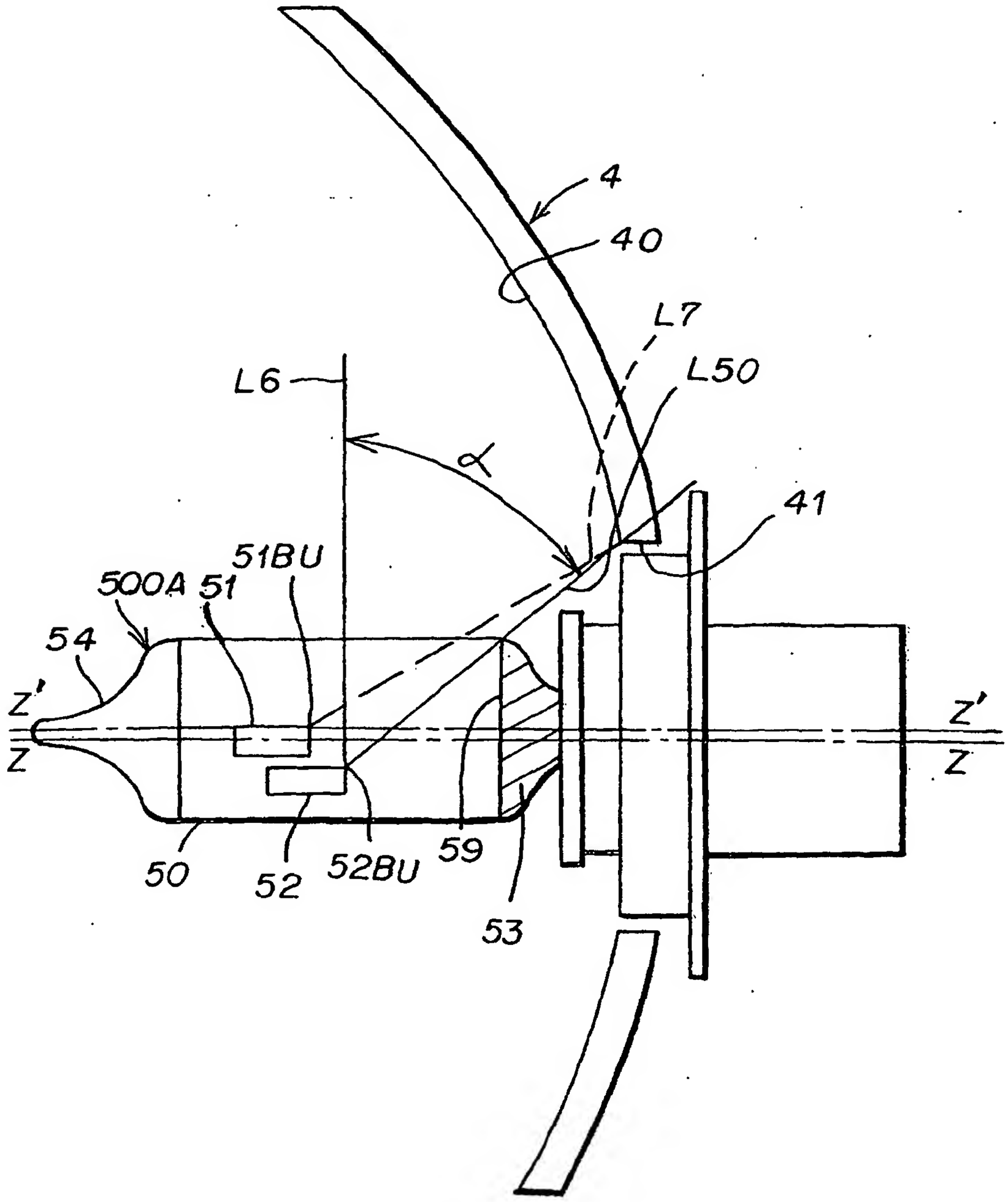


FIG.17

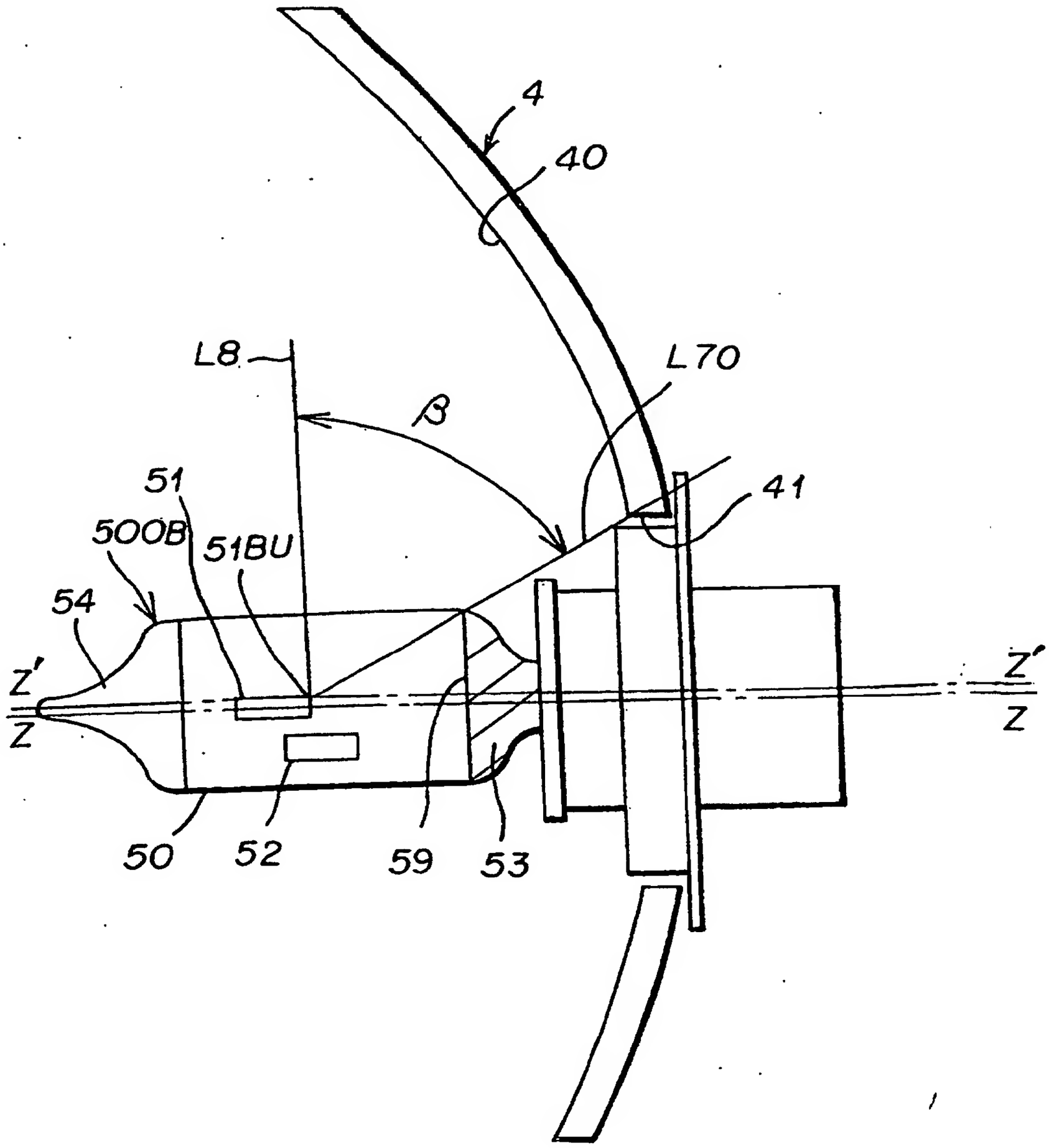


FIG.18A

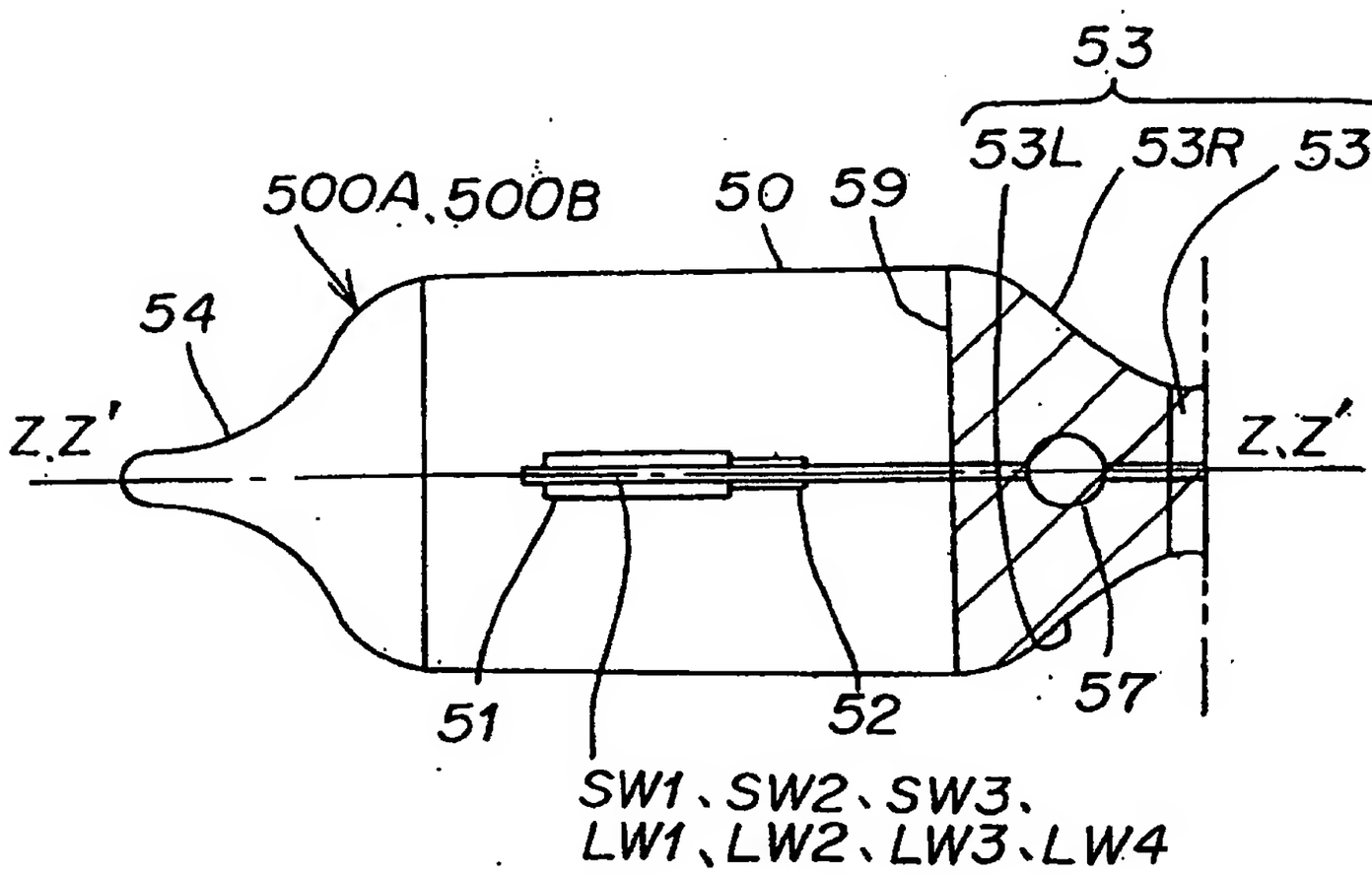


FIG.18B